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REPORT OF ~~OBSERVATIONS~~ Observations

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

DURING THE YEAR 1897,

WITH METHODS OF

PREVENTION AND REMEDY.

TWENTY-FIRST REPORT.

BY

ELEANOR A. ORMEROD, F.R.Met.Soc.

ADDITIONAL EXAMINER IN AGRICULTURAL ENTOMOLOGY IN THE UNIVERSITY OF EDINBURGH; FELLOW OF THE ENTOMOLOGICAL SOCIETY; MEMBER OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON; ALSO MEMBER OF THE ASSOCIATION OF OFFICIAL ECONOMIC ENTOMOLOGISTS, WASHINGTON, U.S.A.; HON. MEM. OF FARMERS' CLUB; HON. AND CORR. MEM. OF ROYAL AG. AND HORT. SOC., S. AUSTRALIA; HON. MEM. OF ENT. SOC. OF ONTARIO, AND CORR. MEMBER OF FIELD NAT. CLUB OF OTTAWA, CANADA; MEMBER OF EASTERN PROVINCE NATURALISTS' SOC., CAPE COLONY, ETC.

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PREFACE.

During the year 1897, as in the recently preceding years, we had not presence of any one special crop attack spreading widely over the country; but the ordinary infestations were mostly present, and in the case of orchard or fruit crops some of the infestations were unusually troublesome. In the absence of any generally prevalent drought in May, the general prevalence of orchard and Oak-leaf caterpillars, which caused such severe damage in the two preceding years, was little reported; but the weather influences of the continued mild winter are keeping presence of some of the crop attacks in activity to a degree which may require attention. From specimens sent me only a few weeks ago, maggot is present unusually early in the young Wheat plant; the very injurious caterpillars of the Small Swift Moth, which feed on different kinds of roots, are also at work; and in Clover I have more than usual presence of maggots of the "Clover and Pea-leaf Weevil" at the roots, and of Eelworm Stem-sickness. In the case of the Wheat and of the Stem-sick Clover, it would be so very desirable to be on the alert to apply (where needed) the requisite dressings, that I just mention what is going forward now, although the observations extend beyond those of 1897.

Amongst some of the special points of enquiry during the past year, more than usual attention has been given to imported insect infestations in Corn and Flour; and amongst Turnip attacks, the appearance of the Diamond-back Moth at various North British localities, rather late in the past season, suggests that it would be desirable to be on the watch presently to check the very first signs of presence of the pest.

Amongst fruit attacks, that of the newly observed species of Shot-borer Beetle, in addition to the destructive kind also

present in Plum wood, is of importance; so is the increased prevalence of the Strawberry Beetle; and the Black Currant Mite has been spreading its wasteful and difficult to counteract presence to a degree which, as will be seen in the "Appendix," is now being made the subject of special preventive experiment. An attack to Apple fruit has appeared in Devonshire of which it is impossible to speak with certainty, but which should be looked to. There is a possibility of it being that of a fly maggot, but also it corresponds minutely in damage done with that of a moth caterpillar, injurious to Apples, of which I have details from Dr. Fletcher, Entomologist of the Experimental Farms of the Department of Agriculture, Ontario, Canada.

The following list enumerates, as in preceding years, the greater part of the more important of the infestations regarding which enquiries were sent, arranged under the headings of the orders to which they entomologically belong:—

Beetles (*Coleoptera*).

Asparagus Beetle, *Crioceris asparagi*	Asparagus shoots.
Bacon Beetle, *Dermestes lardarius*	Meat, &c.
Bone and Leather Beetle, *Dermestes vulpinus*	Bones, Wood, &c.
Bean-seed Beetle, *Bruchus rufimanus*	Bean seed.
Chafer, Cockchafer, *Melolontha vulgaris*	Leafage and Grass roots.
,, Rose, *Phyllopertha horticola*	Flowers, leaves, and Grass roots.
Elm-bark Beetle, *Scolytus destructor*	Elm bark.
Lady-bird Beetles, *Coccinella septempunctata*	Aphides (beneficial).
Pine Beetle, *Hylurgus piniperda*	Pine bark and shoots.
,, Timberman Beetle, *Astynomus ædilis*	Pine bark and wood.
,, Weevil, *Hylobius abietis*	Young Pine bark, &c.
Plum Shot-borer Beetle, *Xyleborus dispar*	Wood.
,, ,, ,, *X. saxeseni* (=*xylographus*)	,,
Strawberry Ground Beetle, *Harpalus ruficornis*	Strawberry fruit.
,, ,, ,, *Pterostichus vulgaris*	,,
Weevil, Apple-blossom, *Anthonomus pomorum*	Apple flower-buds.
,, Granary, *Calandra* (*Sitophilus*) *granaria*	Stored grain, &c.
,, Rice, ,, ,, *oryzæ*	Stored grain, Rice, &c.
,, Pea, Clover, & Bean-leaf, *Sitones* (various species)	Leafage.
,, Turnip-seed, *Ceutorhynchus assimilis*	Seed in pods.
Wireworms (larvæ of various Elaters)	Roots of Grass and crops.

Butterflies and Moths (*Lepidoptera*).

Angoumois Moth, *Sitotroga* (*Gelechia*) *cerealella*	Stored Barley.
Codlin Moth, *Carpocapsa pomonella*	Young Apples.
Currant Magpie Moth, *Abraxas grossulariata*	Currant leaves.
Death's Head Moth, *Acherontia atropos*	Potato leaves.
Diamond-back Moth, *Plutella cruciferarum*	Turnip leaves.
Garden Swift Moth, *Hepialus lupulinus*	Roots of many crops.
Lackey Moth, *Clisiocampa neustria*	Orchard leafage.
Mediterranean Mill Moth, *Ephestia kühniella*	Flour, &c.
Privet Hawk Moth, *Sphinx ligustri*	Privet leaves.
Silver Y-Moth, *Plusia gamma*	Mangold leaves.
Surface Caterpillars, *Agrotis* of various kinds	Turnip and Mangolds.
Tiger Moth, *Arctia caja*	Garden leafage.

Two-winged Flies (*Diptera*).

Cabbage & Turnip-seed Gnat-midge, *Cecidomyia brassicæ*	Turnip seed.
Carrot Fly, *Psila rosæ*	Carrot roots.
Daddy Longlegs, *Tipula oleracea*	Roots of Grass, &c.
Forest Fly, Deer, *Lipoptera cervi*	Hair of Deer.
,, Horse, *Hippobosca equina*	Hair of Horses and Cattle.
Frit Fly, *Oscinis frit*	Oats and Wheat.
Gad or Small Breeze Fly, *Chrysops cæcutiens*	Men and Animals.
Gout Fly, *Chlorops tæniopus*	Barley stems.
Hessian Fly, *Cecidomyia destructor*	Corn stems.
Horse Bot Fly, *Gastrophilus equi*	Horses, internally.
Red Maggot (of) *Cecidomyia tritici*	Wheat ears.
Warble, Horse, *Hypoderma* (? sp.)	Hides of Horses.
,, Ox, *Hypoderma bovis*	Hides of Cattle.
Willow Midge Maggot, *Cecidomyia* (larvæ ? sp.)	Bark of Willows.

Sawflies, Bees, &c. (*Hymenoptera*).

Hornet, *Vespa crabra*	In old trees and wood.
Leaf-cutter Bee, *Megachile centuncularis*	Leaves.
Oak Apple (root form), *Biorhiza terminalis*	Oak shoots and roots.
Oak Spangle Galls, *Neuroterus lenticularis*	Oak leaves.
Sawfly, Apple, *Hoplocampa testudinea*	Young Apples.
,, Corn, *Cephus pygmæus*	In Wheat stems.
,, Pear, *Eriocampa limacina*	Pear leaves.
,, Pine, *Lophyrus pini*	Pine leaves.
Sirex, Giant, *Sirex gigas*	Pine timber.

Aphides, Scale Insects, &c. (*Homoptera*).

Apple-suckers, *Psylla mali*	Stems of blossom buds.
Beech-bark Felt Scale, *Cryptococcus fagi*	Beech stems.
Cabbage Aphis, *Aphis brassicæ*	Cabbage leaves.
,, Powdered Wing, *Aleyrodes proletella*	,,
Mussel Scale, *Mytilaspis pomorum*	Apple and Pear bark.
Spruce Gall Aphis, *Chermes* (*pini*) *abietis*	Galls on Spruce Fir.

Various other insect infestations were present, as of the Lesser Earwig, and also the Common Earwig, which had been previously reported Locusts, as an imported infestation in Lucerne, also gave some trouble; as did also the spread of the small striped Cockroach, variously known as the German Cockroach, and (in the United States of America) as the Croton Bug. Numerous other kinds of insects, economically injurious as affecting woodwork, clothes, carpets, furniture, and linen while bleaching, &c., but not coming under the head of agricultural pests, were also the subject of enquiry.

Amongst different kinds of injurious infestations not coming under the head of "Insect" life, various kinds of "Mites" (which are classed in the order *Acarina*) were more than usually troublesome; and far before them all in importance was the constantly increasing spread of the *Phytoptus ribis*, the "Black Currant Mite," to which I have been giving all the attention in

my power, both personally, and by continental and home correspondence. The very similar *Phytoptus* galls of the Nut, and the *Phytoptus* galls which much resemble blunt-pointed nails red or green in colour standing upright on Lime leaves, were more than usually noticed. Eelworm presence was also worse than usual in respect of causing Tulip-root in Oats, and, as observed above, the mischief continues still in Clover.

From various causes, the correspondence during the past year, which amounted approximately to about three thousand letters received, has been larger than in any preceding season; but by special arrangements I kept it as steadily in hand as I was able, and I trust that if any enquirer was not at once attended to, he will kindly accept the above as the reason.

Independently of insect matters, one chief point of interest of the year was the necessity of attending to the disastrous losses caused by the literally overwhelming amount of prevalence of one species of bird—the House Sparrow, *Passer domesticus*. I may mention that the leaflet compiled by myself (of evidence of the harm caused), with the valuable co-operation of Mr. Tegetmeier (Member of the British Ornithologists' Union), has met such a large circulation (*gratuitously, as it is still continued*) that about 28,000 copies have been distributed at agricultural and other centres in this country, and especially by our parish clergy, also (officially) in most of our Australasian colonies, where the hap-hazard introduction of this bird has caused such boundless mischief. A mass of information comprised in many hundreds of letters to myself gives valuable evidence of the losses caused by this bird, and the documents are preserved for possible future publication.

Once again, as in previous years, I have to acknowledge with grateful thanks the important assistance received in my work from almost all our leading agricultural journals, as well as from many on more general subjects; and my best thanks are also due for the exceedingly liberal donations of valuable publications of which I am very frequently in receipt.

Of the illustrations in my present Annual Report I beg to acknowledge, with thanks, those at pp. 10, 21, 48, 53, 104, 120, and 126, as being by permission of Messrs. Blackie & Son, of Glasgow; the Magpie Moth with closed wings and caterpillar

accompanying on p. 28, and the *Sirex gigas*, p. 69, are figures of which I was permitted the use from the 'Gardeners' Chronicle' set; the others (excepting where acknowledged accompanying) have mostly been drawn expressly for my own publications, and of these about eight now appear for the first time.

The portrait, inserted by request, is from a photo by Messrs. Elliott & Fry, Baker Street, W.

For myself, I hope that I may continue, so long as is wished, to give every attention in my power to such enquiries as may be addressed to me; and I can truly say that I should be both proud and thankful if I could hope to at all lessen the losses to our national agriculturists and fruit-growers by destructive and yet, if attended to, often remediable infestations of their crops.

ELEANOR A. ORMEROD, F.E.S.

TORRINGTON HOUSE, ST. ALBANS:
February, 1898.

List of Injurious Insects, &c., noticed in this Report.

NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

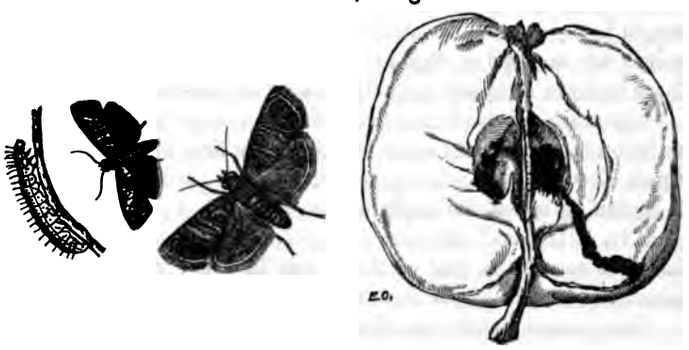
AND

COMMON CROP PESTS

DURING 1897.

APPLE.

Codlin Moth. *Carpocapsa pomonella*, Linn.
Apple Sawfly. *Hoplocampa testudinea*, Cameron; *Tenthredo testudinea*, Klug.



CARPOCAPSA POMONELLA.—Moth, nat. size and magnified; caterpillar; injured Apple.

DURING the past year, severe complaints have been sent from various places as to Apples being, what is termed, "maggotty"; and some part of the losses appear to arise from growers not being sufficiently aware of the differences in appearance, and also in place of winter shelter, between the caterpillars of the Codlin Moth and those of the Apple Sawfly.

The caterpillars of the Codlin Moth crawl to the trunk of the Apple tree, and there they shelter themselves in crevices of the bark, where

they spin a cocoon or web covering, in which they go through their changes; whilst, on the contrary, the caterpillars of the Apple Sawfly go down into the ground, and there, at a depth of two, three, or four inches (or even, if the soil is very friable, at a depth of seven inches), they form their cocoons, from which the Sawfly comes out at the time of the Apple flowers in the following season.

Consequently on this difference in habits, much good time and labour is apt to be more than thrown away in scraping and dressing the Apple tree trunks to get rid of Codlin Moth infestation, whilst all the while the caterpillars of the less known Apple Sawfly infestation may be lying unharmed close by beneath the surface of the ground ready to develop and start new attack with the opening of the next season's Apple blossoms.

The caterpillars of each of the above kinds are so far similar both in size and shape that, without careful examination through a magnifying-glass, it is very easy to mistake one for the other; but, when closely examined, it will be seen that the caterpillar of the Codlin Moth has *four pairs of sucker-feet beneath the body*, whilst the caterpillar of the Apple Sawfly has *six pairs*. By this difference in the number of the sucker-feet, and also by a very disagreeable scent, much like that of a plant-bug, or of a common bed-bug, the caterpillar of the Apple Sawfly may be distinguished from that of the Codlin Moth.

The history of both of the above infestations has been given at length in my Annual Reports,* but the following notes of the chief points are now given together for convenience of comparison where there is doubt as to which of the attacks is present.

The main points of the history of the Codlin Moth infestation are as follows. The moths come out about the time of the opening of the Apple blossoms, and when the blossom-leaves have fallen and the fruit is beginning to set, the moth lays her egg at the eye of the little Apple (that is, at the end opposite the stalk). Commonly only one egg is laid, but sometimes two or three may be laid; and also they may sometimes be laid by the stem of the young Apple, or on the cheek.

The maggot hatches in about a week or ten days, and gnaws its way into the Apple, where its presence is shown by the dirt thrown out at the eye of the Apple, or at the opening of a passage gnawed by the grub through the young fruit to enable it to throw the pellets of dirt out which could not be got rid of by forcing them through the small entrance burrow. It then feeds in the centre of the fruit, piercing the core, and injuring the "pips," and consequently the Apple falls. This is about four weeks after the maggot has hatched. If the maggot is still in the fruit when it falls, it leaves the Apple and

* For Codlin Moth, see 'Twentieth Annual Report,' pp. 1–9; for Apple Sawfly, 'Fifteenth Report,' pp. 1–5, and 'Sixteenth Report,' pp. 10–17.

crawls to a neighbouring tree, and when it has found a convenient crevice in the bark, it enlarges this so as to form a small chamber, where it spins a white cocoon or web over itself, and turns to the chrysalis state, from which, in ordinary course, the moth comes out at the time of the flowering in the following spring. Just possibly it may come out in about a fortnight; but as a general thing it is considered that in this country the moth is only single-brooded. Sometimes, instead of falling with the Apple, the caterpillar leaves the fruit, and lets itself down by a thread, or sometimes it creeps from the fruit along the branches to the trunk; but in whatever way it may leave the Apple, in ordinary circumstances it creeps to the trunk, and spins its shelter as above mentioned.*

The Codlin Moth (see figure, natural size and magnified, p. 1) is about three-quarters of an inch across in spread of the front wings. These are light grey, with many fine streaks and broader marks of a dark tint, and at the hinder corner is a large spot of reddish or gold colour, with paler markings on it, and a border of gold colour. The hinder wings are blackish.

The caterpillar (see figure, p. 1) is from about half-an-inch to three-quarters of an inch in length when full grown; whitish when young, later on more or less of a pinkish colour. The head, when young, is dark, later on lighter in colour; and the shield on the segment next the head similarly varies in colour with the age of the maggot, and so does the tail segment. It has eight little black dots, or warts, on each segment, so as to make two rows down the back, and one on each side; and it has three pairs of claw-feet (one pair on each of the three segments nearest the head); four pairs of sucker-feet beneath the body, and another pair of sucker-feet at the end of the tail.

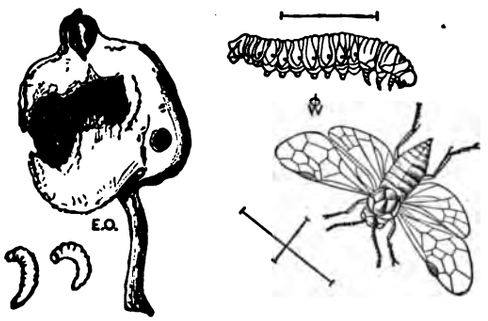
The attention of the reader is particularly directed to the number of the sucker-feet beneath the body being no more than four pairs, and also to the circumstance of the caterpillar, after leaving the fruit, going (save in quite exceptional cases) to the trunk of the Apple tree, as these are points by which the infestation of the Codlin Moth may be clearly distinguished from that of the Apple Sawfly, and the requisite measures of prevention be consequently applied.

Excepting in these two points mentioned above, it will be found that the method of attack of the Apple Sawfly closely resembles that of the Codlin Moth. Like it, the Sawfly (*Hoplocampa testudinea*) appears with the Apple blossoms, and the females may then be seen flying amongst the flowers, and may be caught in the act of egg-laying within

* An instance has been recorded by Mr. Frazer Crawford, in his exhaustive report on the Codlin Moth in South Australia, in which a number of the caterpillars which had let themselves down from Apples growing above a Raspberry bed sheltered themselves in the stumps of the old canes.

them, the exact spot for deposit (in instances recorded) being just below the calyx. In a series of special observations of the habits of these flies, in which they were first noticed on the 14th of May, the caterpillars were found to be hatching out, on the 28th of the same month.

The maggots are pale in colour, and when quite young, that is, when still only about an eighth of an inch in length, the head, and also the plate above the tail, is dark or black; but presently these are moulted off, and when the caterpillars are full grown, that is, about half an inch in length, they are mottled or creamy in colour, with the head pale chestnut, and the plate above the tail and the cross-band immediately preceding mottled with grey, and the three first segments (as in the case of the Codlin Moth caterpillars) have each a pair of claw or jointed legs. The next segment is legless; and then comes the marked distinction between the two kinds of attack under consideration. The fifth to the tenth segments of the Sawfly caterpillars have each a pair of sucker-feet, making six pairs in all, so that with the pair at the end of the tail (which is possessed by the Codlin Moth also), the Sawfly caterpillar has twenty feet in all, whilst the Codlin Moth caterpillar has only sixteen. A comparison of the figures of the two caterpillars will show this distinction clearly.



HOPLOCAMPA TESTUDINEA.—Female Sawfly and caterpillar, magnified, with lines showing natural size, after Prof. J. O. Westwood. Injured Apple and caterpillar, natural size.

The history of the attack of the Sawfly, given shortly, is that the caterpillars hatch in the very young (embryo) Apple, and as this grows, they grow, and feed within, and thereby cause much damage (see figure above), not only to the fruits in which they were hatched, but sometimes to other neighbouring fruits, to which they have the power of straying at pleasure. The injured Apples are not so regularly tunnelled as in the case of damage from Codlin Moth caterpillars. There are, or may be, tunnels, but also (see above figure) much of the inside of

the little Apple may be eaten away, thus causing a rough, blackened cavity with decaying surface.

When the caterpillars are full grown they drop to the ground, either inside the falling Apple or without it; this is found going on during July. They then go down into the ground and form cocoons, in which they spend the winter, and turn to the chrysalis (or pupal) state (which appears to be of very short duration), from which the Sawflies develop at the time of the opening of the Apple blossoms in the following year.

The Sawfly, *Hoplocampa testudinea*, scientifically, has the body yellow or reddish yellow beneath, and a large patch on the top of the head black, as also the top of the body between the wings, and the back of the abdomen; the other parts of the insect are chiefly yellowish. The wings are transparent, with the veins dark, or darker towards the base, and the patch on the front edge of the fore wings dark, but paler at the end nearest the tip of the wing. The length of the body about one-quarter of an inch.

METHODS OF PREVENTION AND REMEDY.—One very desirable method, which is equally applicable to both of the above attacks, is to have the young fallen Apples picked up as soon as possible and destroyed, or thrown where the grubs, if still inside the fruit, will be killed. A gentle shaking of the trees is also not at all an undesirable treatment, as it brings down fruit (which was about to fall) under supervision, and thus it can be cleared away at once.

But the point where remedial measures (for the two attacks, respectively) vary essentially is in the treatment requisite to get rid of the infestations in their *winter shelters*,—in one case from the bark of the Apple trees, in the other from the ground beneath them.

The plan recommended for clearing Apple Codlin Moth in caterpillar or chrysalis stage is to spread old sacks or anything that will catch the scrapings round the trunk of the tree. Then begin to scrape as high up as there is loose bark, and also scrape and clear out cocoons from crevices, and also from the forks of the tree. Scrape downwards until the ground is reached, and then gather up the scrapings and destroy them. After scraping the tree, a wash should be applied to kill any caterpillars or chrysalids that may have remained in crevices in the bark. For this purpose a wash with a basis of soft-soap, with any insect deterrent mixed with it, would be sure to do good, and the choice may be quite left to the grower. The above operation may be carried on at any convenient time during the winter.

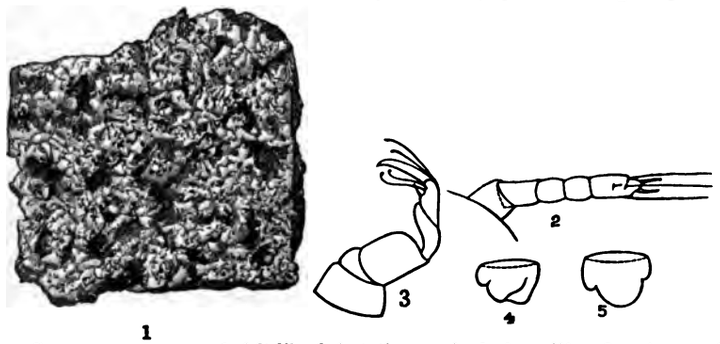
For getting rid of Apple Sawfly cocoons, where the nature of the soil or distance of the root-fibres from the top of the ground permits, such treatment of the surface, as by disturbance, or removal, or by dressing, would open the soil to bird action, or throw the cocoons under weather

influence in winter; or would destroy them by chemical manures injurious to insect life but not strong enough to hurt the root-fibres, are useful, and lime or (in quite small quantity) gas-lime of course suggest themselves, but it might be well to try nitrate of soda. Kainite at a rate of over half a ton an acre has been found useful in U.S.A. experiment on infested Pear orchard land in destroying Pear Midge maggot in the ground, and though the maggot of the Apple Sawfly is larger, and also is protected by a cocoon, still experiment as to the effect of the kainite would be worth while.

Many other preventive measures may be serviceably used with regard to both of the attacks, such as scalding baskets in which infested fruit has been transmitted, hand-picking the Sawflies when in reach, as when settling on the blossoms of espalier Apple trees; but these will be found in the papers on the respective attacks, to which reference is given in the foot-note on page 2. But the above condensed notes of the main points of distinction in habits and treatment on which preventive measures chiefly rest are given together as shortly and plainly as possible in order that growers troubled by "maggotty" Apples may be able to have the information at hand without further trouble in reference.

BEECH.

Beech-bark "Felt-scale." *Cryptococcus fagi*, Baerensprung.



CRYPTOCOCCUS FAGI.—1, felt-like infestation on bark, from life; 2, antenna of larva; 3, leg of larva; 4 and 5, stump-like legs of female, highly magnified, after figures by Karel Sulc.

On March 5th enquiries were sent me on the part of Lord Burton, of Rangemore, Burton-on-Trent, regarding a bark-infestation which

was doing great harm to the Beech trees in his woods at Rangemore. The pieces of Beech-bark, of which good specimens were successively sent me for examination, were almost entirely covered with a whitish coating of a flocculent formation (see figure 1, p. 6). This coating was formed of flattish irregular masses of various thicknesses, from the sixteenth of an inch, or even less, up to about three times that thickness, and thus formed, in some places, only a slight covering to the bark, but was commonly of an aggregation of little soft irregular lumps, with the dark bark showing here and there amongst them, and looking much as if badly mixed whitewash, with the lumps of lime not properly dissolved, had been thrown at the bark of the tree.

In this white coating I found the little orange Coccids, which secrete the felt-like* material, numerously present. The shape of these was scarcely discernible by the naked eye, as they are not as much as half a line in length; but when magnified, they could be seen to be almost globose in shape, orange or yellow in colour, and with soft bodies, sometimes lying singly, and sometimes in numbers near together.

In the supply of specimens, sent me on June 4th, I found Coccids numerously present beneath the white felt. These were of various sizes, the smallest were somewhat oval, or approaching to a cylindrical form, blunt at the extremities, the largest were almost spherical; they were mostly pale in colour, but some were of a reddish yellow. The spherical specimens were females; those that were somewhat narrowly oval were larvæ.

These "Coccids" belong entomologically to the great division of "Scale Insects," which do mischief by piercing into plant-tissues, and drawing away the sap by means of their suckers; but they do not, like many kinds (as the Apple-bark *Coccus*, for instance), form a scale over themselves in their mature stage, they are more nearly allied to the soft fleshy kind, commonly known as the "Mealy Bug"; and the infestation is of considerable interest as a forest insect pest, for, as will be seen from the following observations, it is both widely distributed in this country, and also, unless in situations where treatment can be applied, very hurtful to the infested trees.

In the first communication sent me (on March 5th) by desire of Lord Burton, from Rangemore, Burton-on-Trent, it was mentioned as "the infestation which is destroying all the Beech trees in the woods here."

In a further communication by Mr. W. Bennett, from Rangemore, sent on April 3rd, he mentioned that the specimens then sent were from a tree that was to all appearance dying from the attack, but had

* As this Scale insect does not appear to have any English name at present, I have suggested Beech-bark "Felt-scale," as noting the locality and the appearance of the infestation.

not been treated in any way. Some other trees which had been twice washed during the winter with an insecticide were found to be much cleaner, and it was considered that another similar washing would nearly free them.

In a letter with which I was favoured on April 28th by Dr. William Somerville, Professor of Botany at the Durham College of Science, Newcastle-on-Tyne, he remarked:—

"Thanks for calling my attention to *Cryptococcus fagi*. The insect is very common hereabouts, and, in fact, in most parts of the country. It does a lot of damage too, and I doubt if badly infested trees ever properly recover, unless artificially assisted by dressings similar to those used for the American Blight."

The following note from Mr. J. Eardley Mason, written from Lincoln on April 22nd, shows this Beech-bark infestation to be found near Leeds. Mr. Eardley Mason noted:—

"It was in 1885, as near as I can remember, that in a wood at Headingley, or very near to the boundary of that parish, which is a suburb of Leeds, I noticed splashes of 'whitewash' on Beech trunks. Closer examination showed that these splashes were of insect manufacture. I cut off some, and sent them to Mr. J. W. Douglas, who, in acknowledging the receipt, gave me the name."

Other notes of appearance * mention the attack being noticed in Dalkeith Park (about six miles from Edinburgh), also in the Ravensworth Woods (near Gateshead, Co. Durham), and on Beech trees near Exeter, which altogether give a wide area of distribution in this country.

It has been known under many synonyms, as *Coccus fagi*, of Walker; it was subsequently considered by Dr. Signoret that it should be placed in the series of *Pseudococcus*, where it is accordingly placed by Mr. J. W. Douglas in his paper, referred to below, published in 1886; and more recently, after consultation between Prof. Karel Sulc, of Prague, and Mr. Douglas, it has been placed in the genus *Cryptococcus*, Douglas, species *Cryptococcus fagi*, Baerensprung.

In the paper by Mr. Douglas (see note for reference), he remarks, under the heading of *Pseudococcus fagi*, Baerensprung:—

"At the end of May last, at Blackheath, I saw on the trunk of a Beech tree some forty or fifty years old many white spots of flocculent matter protruding through small cracks in the dry black bark, forming mostly isolated, short, stout tufts or streaks, but sometimes several of them were close together, making conspicuous patches. I cut out some of the bark so affected, and found that the flocky matter extended under the free edges of the cracks, as it were into the dead or dry

* For authorities, see paper by J.W. Douglas, F.E.S., on "Some British *Coccidæ*," Ent. Mo. Mag. for December, 1886.

bark, and there were in each instance from four to eight fat, yellow, oval Coccids lying close together, but each separately in a kind of cell formed in the compact felt-like cottony flocks.

"On July 16th I again visited the tree, and cut out several of the white patches, and found in each eight to twelve pale yellow Coccids closely packed together in the felt-like cotton, and surrounded with eggs. Under the microscope I saw the Coccids were just mature."—(J. W. D.)

The fullest and most recent description of the insect up to present date is that given by Prof. Karel Sulc in his treatise, mentioned below,* under the present name of *Cryptococcus fagi*, Baerensprung, from which I extract some of the main points. Prof. Sulc describes the female as elliptical, almost subcircular, canary yellow colour, and with the marking of the segments on the fore part of the abdomen hardly discernible; simple reddish eyes; antennæ atrophied, so that they form a stump only, bearing two to four short hairs. First and second pairs of legs wanting; of the third only a papillar or saccate stump remaining (see figures 4 and 5, p. 6).

The "first larva" is elliptical, reddish yellow; eyes distinct, reddish brown; antennæ (figure 2, p. 6) five-jointed, third and fourth joints shorter than the others, and equal in length. Legs (figure 3, p. 6) strong; coxa large; trochanter wedge-shaped, with a rather long hair; femur massive, as long as tibia and tarsus together (*i.e.* thigh massive, as long as shank and foot.—E. A. O.). Abdomen distinctly segmented.

Length of the adult female 0·47 mm., breadth 0·44 mm. Male unknown.

In the observations given by Mr. Douglas on this infestation (previously referred to), under the synonym of *Pseudococcus fagi*, Baerensp., he also gives a technical description of the Coccid, with the addition that it possesses "a short appressed covered rostrum, of which the brown tubular end was free, and turned at a right angle, and from this end projected an extremely fine blackish seta." He also mentioned that, at the date of observation, July 16th, he "saw in several instances the actual extrusion of eggs,—large, pale yellow, oval, and transparent."

From the minute size of the insects, as well as the adhesion of the flocculent surroundings, and likewise from their being unicolorous, there is great difficulty to any but highly skilled manipulators in securing specimens for figuring, and I wholly failed in the matter; but

* See "Studie o Coccidech" ("A Study of Coccids"), by Karel Sulc. F. Rionace, Prague, 1895. 8vo, pp. 1–27, 3 plates. This publication is an extract from the Transactions of the Inst. for Comp. Anat. and Zoology, Bohemian Univ., Prague, and is issued separately, with English translation accompanying.

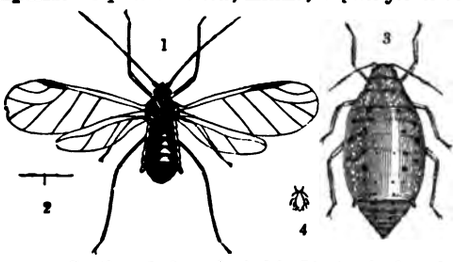
whilst preparing this paper, I was favoured by Mr. Robert Newstead, of the Grosvenor Museum, Chester, with a sight of his beautiful figures, drawn from life, of this Scale insect, *Cryptococcus fagi*, prepared by him for one of the illustrations of his 'Monograph on *Coccidæ*' for the Ray Society. These figures give full and excellent representation of the upper and under side of the female *Coccus*, with all details; and likewise of the larva, showing the narrower form, the six legs in position, and many additional much-magnified figures, which will be of the greatest service to future students of this infestation.

In regard to methods of prevention and remedy, probably syringings or washings of water would be useless, as in some experiments which Mr. G. B. Buckton, F.R.S., was good enough to try for me on specimens of infested bark, he found that the felt-like or "furry" matter was quite insoluble in water. Probably soft-soap washes, with a little sulphur, or a little mineral oil of some kind, incorporated in them, would clear the infestation well, for they would be prevented by the "felt" from running off at once, and thus remain to destroy the contained insects or eggs.

But here, as with other forest insect attacks, it would be impossible at a paying rate to apply dressings to large areas of infested woodland. Small numbers of trees, or trees which for any particular reason it was wished should be preserved, might in all probability be cleared from the attack, but further than that, remedial measures do not seem available.

CABBAGE.

Cabbage Aphis. *Aphis brassicæ*, Linn.; *Aphis floris rapæ*, Curtis.



APHIS FLORIS RAPÆ, Curtis.—1, 2, male Aphis; 3, 4, wingless female—natural size and magnified.

On July 23rd specimens of very bad attack of Cabbage Aphis were sent me by Mr. Samuel Fraser, from the Cheshire Agricultural and

Horticultural School at Holmes Chapel. Of these, Mr. Fraser wrote:—

"I should feel much obliged if you could give me any information about the enclosed 'Aphis' on the Cabbages. The last two or three days have been sultry and close, and the Aphis have increased wonderfully. Where one Cabbage was attacked two days ago, a dozen all round it are attacked now. They cover the leaves completely in some cases, and render them white, thus checking growth, and nearly killing the plant; the very luxuriant ones are not attacked. The piece of land worst infested is where we had some Potato-pits last winter."—(S. F.)

The specimens sent me covered the Cabbage leaf almost solidly for a space of about six inches in length, up to as much as one and a half in breadth, and the aphides were packed together, even to being one on the other, besides more scattered presence of attack ranging up to about seven inches in length by four in breadth.

The youngest aphides were yellowish in colour; the older specimens, in the condition answering to the pupal state (of which there was the largest proportion), were dull or dirty greenish, much corrugated across, and with black or grey-black wing-cases. The females were green in the abdomen; head and most of the body between the wings black. Very few winged females were present when the specimens reached me, but on opening the box, where I had put them aside, a few days afterwards, the great number of winged females which had developed was very observable.

This species is the same as the *A. floris rapæ*, of Curtis, of which he remarks ('Farm Insects,' p. 70) that it "is readily distinguishable by its white dusty appearance, with which both sexes are thinly coated," and the white dusty appearance was very noticeable in the masses of specimens sent me.

In the hollow formed by the central vein of the Cabbage leaf there were balls of a white formation, which, on examination with a magnifier, proved to be globules of moisture, apparently exuded by the aphides, and covered with white powder from their own mealy coating, which prevented the drops running together. On crushing some of the drops on a piece of blotting-paper, the moisture spread about on the paper, and the white mealy deposit was in sufficient quantity to remain noticeably on the surface.

The description of the wingless female* is:—"Body long oval, plentifully covered with a mealy coat, both on the upper and under sides. When this is removed by a drop of spirits of wine, the body below is greyish green, with eight black spots ranged down each side of the back, which increase in size as they approach the tail. Antennæ

* See 'Monograph of British Aphides,' by G. B. Buckton, F.R.S., vol. ii. p. 84.

green, with black tips, shorter than the body. Eyes and legs black. Cornicles very short and black. Tail also small and black."

The male of *A. floris rapæ* is described by Curtis as dull pale green, dusted with white; eyes, head, disk of the thorax, and abdomen varied with black; legs ochrey, apex of thighs, shanks, and feet black (see figures 1 and 2, p. 10).

This species is a distinct one from what may be called the common Turnip Leaf Aphis, now known as *Rhopalosiphum dianthi*, Schrank, which is not only a severe pest at times to Turnip leafage, but also is to be found very generally distributed on garden and field crops; but, as mentioned in Mr. Buckton's work (quoted above), the "confusion in the synonymy of this Aphis is very great."

The "Cabbage Aphis," *A. brassicæ*, feeds on a good many kinds of plants besides Cabbage, but to this it is especially destructive from the enormous quantities in which it infests not only the upper, but the lower sides of the leaves.

Prevention and Remedy.—All measures of preparation of ground and of cultivation generally which are calculated to push on good growth are of service, not only in keeping up the strength of the plants when suffering from loss of sap drawn away by the suckers of the aphides, but also by making the plants themselves less suitable for multiplication of the aphides. It has long been found that where plants are stunted from drought, or other circumstances which keep back growth, that increase of the "Plant-lice" takes place more rapidly, and it will be noticed that in Mr. Fraser's observations, p. 11, he especially mentions the wonderfully rapid increase of the aphides after two or three days of remarkably close and sultry weather.

In field Cabbage growing, such plentiful manuring is a regular treatment that nothing more seems wanted on this head; but on a smaller scale, attack might be lessened by more attention beforehand to such thorough cultivation as would let the roots go down to their full natural depth, and thus save them from being dried, and not drawing up requisite supplies in temporary droughts. Amongst special manurial applications kainite has been recommended, but I have not definite record either of quantity or effects; but nitrate of soda would be an excellent application from its rapid action when melted into the ground by return of rain after drought, or by artificial watering, where this could be applied.

In garden cultivation, applications of liquid manure would be very useful, and even water alone plentifully applied is useful both in refreshing the plants, and washing off some of the lice.

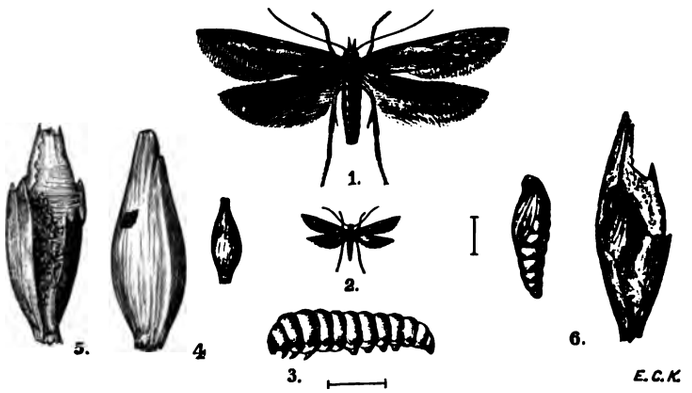
For dry dressings, soot, or lime, or any of the usual mixtures used for similar purposes, do some good; but where "kerosine emulsion"

(for recipe, see Index) can be mixed, this would probably do more good as a washing or syringing than any other application. There is, however, so much difficulty, both here and in America, where it is so greatly used, in permanently blending the soft-soap wash and kerosine, that (as unless this is done properly, much damage is caused to leafage) I have found a very similar mixture sold by Messrs. Morris, Little & Son, of Doncaster, to be a good substitute. This is very similar to the American emulsion in ingredients, but is sold ready mixed in semi-fluid state, so that it only needs diluting, and I can speak from personal experience as to it answering well where I have known it to be used for getting rid of Aphis on Cabbages.

Some amount of difference in the spread of attack may be made by burning infested plants, and also by destroying wild plants on which the "Plant-lice" are feeding, as, for instance, "Charlock" (*Sinapis arvensis*) and "Shepherd's Purse" (*Capsella bursa-pastoris*); but these arrangements are hardly practicable except in garden cultivation or on small plots.

CORN.

Angoumois Moth; Fly Weevil (U.S.A.). *Sitotroga* (*Gelechia*) *cerealella*, Oliv.



SITOTROGA CEREALELLA.—1 and 2, moth, magnified and natural size; 3, caterpillar, magnified, and line showing natural length; 4, pierced grain, natural size and magnified; 5, grain with frass, magnified; 6, chrysalis in grain, and removed, magnified, and line showing natural length. From North African Barley.

The grain infestations of the "Angoumois Moth" have long been known as the cause of serious losses in France, and in other countries

where the warmth of the climate suits it for propagation; and in more northerly localities bordering on infested areas, where occasional variations in temperature may allow it to establish itself temporarily, or breeding may be continued on grain in warm stores, the possible appearance of this attack, by importation or otherwise, is one of those regularly watched for by those who are connected with prevention of damage from injurious insects.

The moths much resemble what are commonly known as "Clothes Moths," and the mischief is caused by the maggots, which hatch from the eggs laid by the moths on matured corn, penetrating into the grains, and clearing out the contents, so as to reduce them to mere husks, emptied of everything excepting the dirt resulting from the feeding of the maggots, and some remains of chrysalis-cases, web-cocoons, or moulted skins.

The moth takes its name from Angoumois, a province of France, where it was observed as being destructive so far back as early in the last century. From published records, the attack of the insect was known of in Europe (in this case to stored Barley in France) in 1786, but the moth is stated not to have been described until 1789.

In America it is said to have been recognized as early as 1728, and is considered to have been "unquestionably imported by the early settlers of Virginia in their supplies of Wheat brought from the old country. From this centre it has spread in all directions through the country, but more extensively towards the south than towards the north, since it does not thrive in a very cold climate." *

I do not find it mentioned as an *English* pest, either by Kirby and Spence, or by John Curtis in his excellent description of the infestation in 'Farm Insects'; and in the paper on this insect given by Mr. C. G. Barrett, F.E.S., † he mentions that in his "own experience the moth has been taken in plenty about the granaries of the docks at King's Lynn, yet no instance of its spreading abroad among the barns or grain-stores of Norfolk was, so far as I can ascertain, ever observed."—(C. G. B.)

The specimens from which my own observations were taken were from a cargo of Barley imported from North Africa, which proved to be infested to such a degree as to attract attention of intending purchasers, and of which samples were sent me for certainty of the nature of the attack.

On the 4th of February in the past year (1897) specimens of

* See "The Angoumois Moth, or Fly Weevil," by L. O. Howard. 'Insect Life,' Periodical Bulletin of the United States Department of Agriculture, vol. v. p. 325.

† See Ent. Mo. Mag. for January, 1897, p. 9.

Barley were forwarded to me by a Liverpool firm,* with the following observations:—

"We enclose a few grains of North African (Tripolitan) Barley, which you will notice show a small perforation. Although such grains appear among the Barley in quite infinitesimal quantities, yet some of our English maltsters are afraid to use the Barley (although considering it otherwise suitable) because they fear that the perforations indicate the presence or the possibility of weevils. Although we believe this fear to be entirely without ground, we venture, as the matter is one of considerable public interest, to ask your opinion,—(A) as to whether the perforation indicates weevil, or any danger of such developing; (B) as to the insect which causes the perforation, and if any eggs are left in the grain, whether same are likely to cause injury?"

The matter being obviously of importance, I examined every one of the Barley grains sent me by cutting them open and ascertaining the nature of the contents under a powerful magnifier, and found that the damage had been done, not by the maggot of any kind of true weevil or other beetle, but by the caterpillar of a very small moth, and investigation of other specimens (from which I was able to take the infestation both in grub and chrysalis state, and was also able to rear specimens of the perfect insect) showed it to be of the moth known under the various synonyms of *Sitotroga cerealella*, of Olivier, and also of *Butalis cerealella* and *Gelechia cerealella*, of the same observer. Popularly it is known for the most part as the "Angoumois Moth," although in America the name of "Fly Weevil" is still applied to it, as it was before the year 1791, not only to this infestation, but also to those of the Granary Weevils, *Calandra granaria* and *C. oryzæ*, which it resembles so much in its method of injury to the grain.

The mode of attack is for the female moth to lay her eggs, up to as many as twenty or thirty in number, singly or in lines and clusters (and especially along the longitudinal furrow) on ripened or nearly ripened corn whilst standing in the field; but egg deposit may also take place on stored corn in granaries, and from this cause, where temperature is suitable for propagation, a constant presence of the attack may be kept up.

Barley appears to be especially liable to attack, but Wheat is also subject to it, as well as other cereals, and likewise Maize, or Indian corn, as well as Buckwheat, and seeds of some other crops, in which it would only trouble us as an imported pest.

The eggs are red or orange red in colour, and from these the little whitish caterpillars, which at first are hardly thicker than a hair,

* I am requested, for trade reasons, not to mention the name of the firm; but I may further say that the infested cargo, regarding which enquiry came to me through their hands, was not shipped to themselves, but to one of our eastern ports.

hatch out in about from four to seven days, and proceed to bore into the grains, and feed on the material within them. In the case of Maize, it has been found that two or three or even more caterpillars may be found in one grain; but in the case of Wheat or Barley, or our other cereals, one maggot only is found in one grain kernel, and each kernel contains enough material to support its occupant until it is fully grown. Then, after gnawing a little round hole in the side of the grain as a way for escape when the change to moth condition has taken place, the caterpillar spins a web cocoon, which occupies a part of the inside of the emptied coat of the grain, the rest being occupied with its castings, or pellets of rejected matter, and in this web the caterpillar goes through its change to the chrysalis state (see figure 6, p. 13).

The moth (see figures 1 and 2, p. 13) is rather more than half an inch in spread of the fore wings; antennæ long and fine, appearing a little beaded when magnified; proboscis long, and very noticeable; the general colour of the whole insect, including in this all excepting the hinder wings (which are of a leaden grey), is of a light grey or somewhat ochrey tint, described by John Curtis as like "coffee and milk"; the specimens which I reared were of the yellowish tint. The fore wings, which are straight with a pointed apex, have some black markings (see figure), or some black atoms, sprinkled at the extremity, and also on the inner margin of the fringe, and the lower surface is of a rosy shining brown. The hinder wings are bordered with a long and delicate fringe.

The length of the caterpillar is about two- to three-eighths of an inch; the specimens which I measured after taking them from the North African Barley were only about a quarter of an inch long, and the grub thick-made for its length. The colour whitish, mouth parts of different shades of chestnut or of darker brown, and in the best living specimen two very fine lines of brown ran up the centre of the face from the lowest part. The pairs of claw-feet on the three foremost segments were very small, and when seen through a two-inch focus-glass appeared almost like mere pale-coloured claws; and the four pairs of sucker-feet beneath the body (viewed with the same power) were only just perceptible.*

* In the very interesting account given by Mr. C. G. Barrett, F.E.S., of the infestation of this moth, *Gelechia* (*Sitotroga*) *cerealella*, Oliv., in connection with Maize imported from the United States, he mentions that "the larva seems to be yellowish throughout. When full-grown, it is one-fourth of an inch in length, excessively sluggish, with extremely small head partially withdrawn into the second segment; legs and prolegs minute and obscure; body thick, excessively wrinkled; segments deeply divided. Head pale yellowish, with a brown spot on each lobe, and very small darker brown jaws. So stupidly inert as apparently to be fit only to lie in a cavity of the grain, and eat the starchy contents, packing away its excrement in white granules in the cavity behind it."—Ent. Mo. Mag. for January, 1897, p. 8.

In order to form a general idea of the amount of infestation that might be present in the sample of North African Barley sent me for examination, I tried the experiment of placing about a handful of the Barley in a bowl of water, stirring it well round in order that it might be all equally wetted, and noticing how much of the grain floated. The plan answered so well, that I should say it might be fairly trusted to as a guide to ascertain amount of infestation in suspected samples, for almost all the infested grains appeared to come to the surface.

When the grain is in its customary dry state, the little round maggot-perforation in the side may, from its exceeding minuteness, easily escape observation; but in the test by floating, the injured grains are much more readily noticeable, by reason of the moistened outer coat of the Barley swelling, and in its expansion showing the perforation plainly. With regard to *un*perforated grain, there is little observable (excepting to very careful touch) to show which is infested or otherwise, but when moistened the infested grains will be found to give way before pressure from a finger-nail, and thus, where attack is set up, show presence of the maggot which has destroyed the substance within.

In regard to some sort of estimate of amount of attack present in the sample sent me: on placing about six and a half ounces of the North African Barley in water, a few light grains immediately floated to the surface, and after leaving the Barley undisturbed for rather over forty minutes, I found about eight more grains had floated, and on disturbing the soaking grain thoroughly, I did not find that more infested grains worth mentioning came to the surface. Altogether the grains that floated amounted to about a table-spoonful, some of which were certainly infested, but I did not open them all.

In the short account of this infestation by Mr. F. H. Chittenden referring to its life-history in the United States of America, it is stated that in three weeks or more, according to season, the caterpillar attains maturity, and that the entire period from egg to adult state embraces in summer time about five weeks, and in colder weather considerably longer; but also that there is "an irregular development influenced by temperature." Observation is given that in the latitude of the district of Columbia, in an outdoor exposure, there are probably not more than four broods in the year, the insect hybernating as larva in the grain; but in a heated atmosphere there is a possibility of five or six generations annually. In the warmer climate of the south, where the insect can breed uninterruptedly throughout the winter, it has been estimated that as many as eight generations may be produced.*

* See "Some Insects which are Injurious to Stored Grain." Farmers' Bulletin, No. 45, p. 7. By F. H. Chittenden, Assistant Entomologist, United States Department of Agriculture.

In the more northerly localities, the mischief is much less important until, with increase of lowness of temperatures, the insect, even if transmitted, ceases to be able to establish itself.

In the case of the sample of North African Barley which I had the opportunity of watching, development of the moth did not take place, so far as I observed, until more than two months after receipt of the infested grain. On April 16th I noticed that some grains of the sample which I had received on February 4th or 8th appeared to be showing more perforation, and I netted them over, so as to prevent escape of any moths that might develop, and on April 20th I noticed the first specimen of the *S. cerealella* had appeared, and on moving the Barley I found another. I did not take the dates of other subsequent appearance, but one of the last, so far as I am aware, out of this sample of Barley did not appear until after May 19th.

The infested Barley, from which samples were sent me, "was harvested in May or June, 1896, was in store in North Africa until the following November, when it was shipped to ——,* where it now lies" (February 8th, 1897). My correspondents further remarked:—

"Although, as we have said before, it is almost invariable to find indications of the presence of the moth in the Barley as brought in from the fields in Tripoli or Tunis, yet it does not seem to be considered as destructive by the natives to any appreciable extent, although Barley is sometimes kept closed in silos in the dark for two or three years, so it would appear the insects do not increase very rapidly."

The points involved in the above observation as to how far development is influenced by temperature, amount of light, and also pressure from weight of grain preventing ingress of the moth for egg-laying, and egress of such moths as may develop in the stored corn, are of much practical importance, and I give some notes below, as though it may be reasonably conjectured from experience in other countries that we are not likely to be troubled with Angoumois Moth on standing corn in this island, yet as a stores' pest it may require attention.

Prevention and Remedies.—The point where this infestation is to be dealt with is in the stored grain. It is laid down by Dr. L. O. Howard, Entomologist of the United States Department of Agriculture, in the American observations, which are the fullest that we have on this insect, that it passes the winter only in the barns and storehouses. It will breed uninterruptedly generation after generation in stored Wheat. At the time of harvest the moth flies out from the granaries to the Wheat fields, and will lay its eggs on grains of Wheat in the

* Name of port omitted by request.

shocks. The larvæ are not destroyed in the threshing, and are carried in the grains to the granaries.*

The following notes by the entomologist to the New Jersey Agricultural College Experiment Station, and the New Jersey State Board of Agriculture, U.S.A., convey on the same points such useful practical information, that I quote the passage almost entire from Prof. John B. Smith's serviceable volume on 'Economic Entomology' † :—

"The insects sometimes lay their eggs upon grain in the fields, and when it is cut and brought into the barn, they continue breeding in the mow so long as it remains there. Corn-cribs frequently become infested, and the insects breed as long as the temperature remains mild.

"Where grain is threshed and bulked, the upper layers may be infested, but the insects are not able to get in very far, because the moth is unable to escape through any heavy layer, becoming worn out, and dying before reaching the surface. The insect is much more troublesome southward than it is to the north, where the cold weather checks breeding before it has an opportunity to do much damage; but in regions where the temperature in the barns is moderate throughout the winter, it frequently does great injury.

"The best remedy is threshing and bulking the grain as soon as possible, covering the bins to keep out the insects. If infection is noticed, it can be easily checked by evaporating bisulphide of carbon in a dish upon the surface. The vapour is heavy, and sinks through it to the bottom, effectually clearing out any insects that may be present. In corn-cribs, the bisulphide can also be used, but the crib must be temporarily closed by canvas or sheeting, so that the vapour may become effective before it escapes.

"It has been found by experiment that grain can be exposed to this vapour for a considerable time without losing in germinating qualities, but seed Wheat should be, if possible, kept free from such insects. . . . Open corn-cribs should be placed in such a way as to get the benefit of all the cold weather there is, and thus the multiplication of the insects will be checked so early that no serious damage will be done."—(J. B. S.)

It should perhaps be observed in passing, that in the above extract the word "corn" is used in the American sense, and is to be understood as Indian Corn or Maize; but the treatment is equally applicable to Barley, Wheat, or other of the cereals in which the "Angoumois

* See "The Angoumois Moth or Fly Weevil (*Gelechia cerealella*)," by L. O. Howard. 'Insect Life,' vol. v. p. 326. United States Department of Agriculture, Washington.

† See 'Economic Entomology,' by John B. Smith, Sc.D., p. 326. Philadelphia: J. B. Lippincott Company. 1896.

Moth" is more likely to be troublesome to us in this country than in Indian Corn, excepting when this comes to us as an infested import.

In regard to the amount of bisulphide of carbon to be used, this of course varies with the space to be treated, and good directions as to amount, method of use, and the great need of care in using the highly inflammable liquid, will be found in the paper by Dr. Howard on the "Angoumois Moth," before referred to ('Insect Life,' vol. v.). It is mentioned that when used in bins, a pound and a half to a ton of grain is an amount that has been recommended. "When used in a reasonably close room, or in a nearly empty bin, one pound of the bisulphide should be evaporated for every one thousand feet of cubic space; or in a space ten by ten by ten feet, one-third of a pound in each of three shallow vessels for a space of these dimensions. For a space ten by ten by twenty feet use two pounds in six vessels, . . . and so on. Make the room as tight as is convenient.* A good time to treat the grain is on Saturday afternoon. Place your pans of bisulphide in position, close the room up tightly before dark, and leave it closed until Monday morning. Then air the room thoroughly, and stir the grain to some extent. The vitality of the grain will not be injured in the least, nor will its edible qualities be harmed. *One point should be always borne in mind in using bisulphide of carbon, and that is its extreme inflammability; its vapour when confined is even explosive. No light or fire should be brought in its vicinity.*"—(L. O. H.)

I have used italics in the above sentence to draw attention as fully as possible to the very dangerous nature of the application unless used both with knowledge and care. I have myself seen ignition occur in the open air from the heat of the sun's rays. Also it should be remembered that the vapour of the bisulphide is prejudicial to the health, or even dangerous if inhaled in large quantity.

Another method of destroying infestation is to subject the attacked grain to a raised temperature.† It appears that it is not "so much the intensity of the heat as its continued action for a certain period which kills the caterpillars and chrysalids in the grain, so that from 45° to 50° during twenty-four or thirty-six hours produce more effect than 76° or 96° for one hour. Of course the heat must be regulated so as not to destroy germinating power, and it is stated to be considered that it is preserved at 190° Fahrenheit."

I have no personal knowledge on this point, and would advise investigation so as to make sure before trying the above plan. The heat may be applied in some form of heated oven or chamber, or in an ordinary room, or (formerly) by means of an iron cylinder, or other

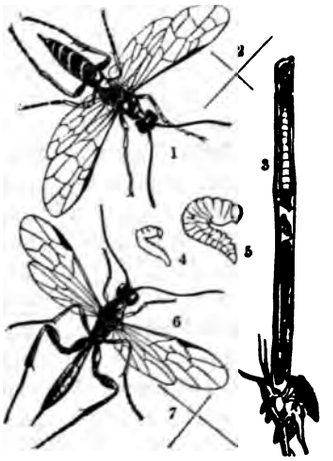
* And let the operator be careful not to shut up either himself or any living creature, excepting the insects to be destroyed.

† See 'Farm Insects,' by John Curtis, p. 313.

form of apparatus in which the grains could be exposed to a regulated amount of heat.* But at the present day, method of storage of the grain and fumigation appear to be the approved remedies.

There does not appear to be any reason for fear of the attack of "Angoumois Moth" establishing itself as a field pest in this country; but as we find that now we are open to its transmission on the broad scale of infested cargoes, we may have loss and difficulty in this respect, and in cases where the damage only affects the value of the Barley slightly for use for malting, probably the best course would be to sell the grain as soon as possible for immediate use.

Corn Sawfly. *Cephus pygmæus*, Curtis.



CEPHUS PYGMÆUS.—1, 2, Corn Sawfly, magnified, and line showing natural length; 3, infested stem; 4, 5, maggot, natural size and magnified; 6, 7, parasite fly, *Pachymerus calcitrator*, magnified, and line showing natural size.

The damage done by the Corn Sawfly is caused by the fly piercing the growing corn stem with her egg-laying apparatus, and laying an egg within, the maggot from which eats its way upwards, piercing through the successive knots. When nearly full grown it returns downwards, and about harvest time bites a ring round the inside of the stem at the ground level or thereabouts, but without damaging the outer part of the straw. Having done this, the grub goes yet further down into the lower part of the stem, and there it spins itself a cocoon, a silken case, in which it passes the winter.

Meanwhile there may be little in the appearance of the crop to draw attention to what is taking place, excepting that the ears look

* For full details see Curtis's 'Farm Insects,' pp. 313, 314.

thin, and not of the right colour, and also are without the proper amount of grains, or perhaps have none at all. But presently, that is, towards harvest time, if there should chance to be a high wind, or the attack is severe, the mischief will be thoroughly noticeable, consequently on the great quantity of straw broken off (as if "laid" by the wind) at the grub-bitten ring just above ground-level.

The attack sometimes is very injurious, and is widely distributed on the Continent, but is by no means one of frequent occurrence (at least to a noticeable extent) in this country. On looking over my Annual Reports from 1877, inclusive, up to date, I find that in 1878 it was slightly noticed, and in 1880 it was reported from two localities, one near Ashford, in Kent, the other near Maldon, in Essex, and it was remarkably numerous at both places; but, excepting in the above-mentioned instances, I have no reports of its presence up to 1885, inclusive. In 1886, the year of the appearance (as a crop pest in this country) of the Hessian Fly, we had observations also of some degree of presence of the Sawfly; and in 1887, the great year of Hessian Fly, we had also the largest amount of Corn Sawfly attack of which observations have been sent. In 1888 there was some amount, but in the succeeding years there has been either no report, or none worth record, until in the past season some slight mention has again been sent in.

In the case of an attack of this kind, which has a capacity of doing great mischief, and also (consequently on the habit of the insect of wintering in the very lowest part of the stubble) can be greatly kept in check by common agricultural measures, it may be of use to note, as above, the date of its appearances, and to give some additional details of habits of the insect, and means of preventing its ravages.

On August 2nd some very characteristic specimens of the attack in Wheat stems were sent me by Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants. The stems were pierced through the knots, and the joints more or less filled with the "frass" or dirt from the insect-workings, and in one stem I found that the larva (grub) had spun its case for wintering in, down near the ground-level.

The grubs of this *Cephus pygmæus* (like the others of the family of the *Cephidæ*, to which it belongs) are footless, excepting three pairs of very small tubercle-like feet on the fore part of the body. At the extremity of the tail is a projecting point, which can be drawn in or extended like a telescope, and this helps the maggot in its progress along the inside of the straw. The head is rusty-coloured, horny, and with strong jaws. The general colour is white or yellowish white, the texture fleshy, the length about half an inch, and the shape as figured at 4 and 5, p. 21, thickened in the part next the head. The maggot feeds on the soft inner portions of the straw, and after having travelled wholly or partly up the stem and come down again, and spun itself up

in a cocoon within the lowest part of the stem, as mentioned at p. 21, it spends the winter (still in larval state) in this shelter. In the early summer it changes to the chrysalis state, from which the Sawfly comes out in time to lay her eggs on the corn; it is considered that one egg only is laid in each stem, the female fly continuing to lay on successive stems until her supply of eggs is deposited. Wheat and Rye are both subject to attack, and Barley occasionally suffers.

One of my correspondents who was well acquainted with the appearance of the attack reported it in 1887 as present in Barley stems in the neighbourhood of Goring Heath, near Reading, but he observed that Oats were not infested, even when growing in the same field mixed with the Barley.

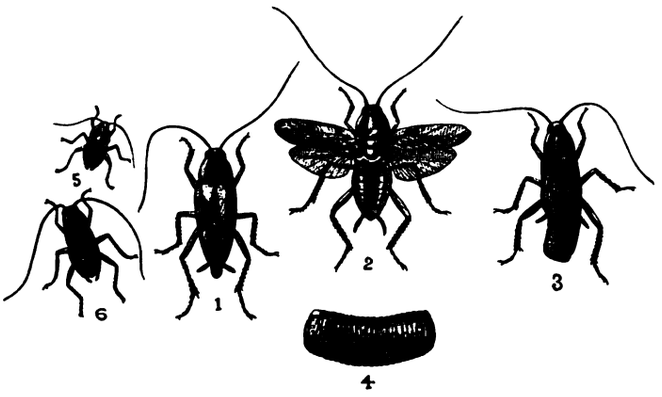
The fly is of the shape figured at 1, p. 21, and about a third of an inch in length. The general colour black, varied more especially in the male with yellow. The antennæ black and yellow. The flies are to be found in summer on grass in woods, and on flowers in corn-fields, and especially on those of umbelliferous plants.

Prevention and Remedies.—The maggot winters in its spun case in the lowest part of the corn-stem, at or below the ground-level, where it is left undisturbed by the falling of the upper part of the stem which it had cut through, and any method of destroying the stubble, in which it is thus harbouring, is an effectual method of clearing the infestation.

This may be done by whichever of the common agricultural methods is preferred. All that is needed is to skim or loosen the surface, so that the lumps of stubble may be collected and gathered in heaps and burned. Common ploughing in is not to be trusted, for a great deal of the stubble would not be buried away deeply enough to prevent the fly coming up through the ground at hatching time. Some part of the infestation would be got rid of, but not all. Where burning the standing stubble can be conveniently managed, this is an excellent plan for killing the grubs, but this is so rarely done that there is risk of causing more harm than the good would counterbalance. Where, in case of bad attack, it is wished to try this plan, it may be safely managed in the Canadian method by firing the field first round the borders. Thus, instead of the fire going wildly where the wind may drive it, there is only a slight heat at first and a line of fire under control near the hedges. The fire thus spreads over the dry stubble towards the middle of the field, and the flames cannot return over the already charred surface.

COCKROACHES.

German Cockroach; "Croton Bug" (U.S.A.); **"Steam Flies."** *Phyllodromia germanica*, Linn. **American Cockroach.** *Periplaneta americana*, Linn.



PHYLLODROMIA GERMANICA.—1–3, adult insects; 2, with wings expanded; 3, female with egg-sac attached; 4, egg-sac;—all magnified; 5 and 6, young, still wingless forms. After figures by Prof. Riley, and specimens.

For some years back enquiries have been sent me from time to time regarding the best methods of getting rid of the exceedingly inconvenient presence of the small yellowish brown, striped Cockroach, generally known as the "German Cockroach," but frequently, in the United States, as the "Croton Bug."

In one instance, the infestation was complained of as causing great annoyance on one of the lines of steamships from the north of Ireland to the United States of America; in another (reported in 1896), a good deal of detail was given of amount of presence, and of means which proved only partially successful in getting rid of the pest in a large hotel in one of our chief manufacturing towns in the north of England, where it was mentioned that "We are, like most other hotels, much troubled with what are called 'Steam Flies.'"

It appears now, however, that this small kind of Cockroach is very widely distributed in this country, and by reason of its greater rapidity of multiplication than our long established kind (popularly, though very incorrectly, known as "Black Beetles"), and also its greater destructiveness, it would be such a serious inconvenience for this species to be generally established with us, that it may be of use to refer to it again this year.

These "Croton Bugs," or German Cockroaches, are only about half an inch or very little more in length at their fullest size, and are marked as shown in the figures at p. 24. The colour is variable, but may be described generally as of a light or yellowish brown, with two dark stripes running along the upper surface of the fore part of the body. By these distinctions of size and colouring, this *P. germanica* may be known from our common larger and dark pitchy-coloured Cockroach, vulgarly known as a "Black Beetle," scientifically as *Blatta* (*Periplaneta*) *orientalis*, and there is the further distinction that while both males and females of the German Cockroach possess two pairs of wings, our own long established "Black Beetle" is only winged in the male sex. The female is wingless, excepting some amount of rudimentary development chiefly, if not entirely, of the upper pair.

In regard to various localities where the *P. germanica* has been seen, Mr. G. H. Carpenter, F.E.S., writing to me from the Museum of Science and Art, Kildare Street, Dublin, on May 21st, observed:—"We have had outbreaks of the German Cockroach in the Zoological Garden here, and at one or two private houses."

I had also a somewhat interesting observation from a relative, resident in St. Bartholomew's Hospital, London, of an establishment of the "Common Cockroach" in one part of a block of the buildings, and of the German Cockroach in another part of the same building, each kind living quite apart from the other. It was a matter of some speculation which kind would drive the other out, but at the last information which I received, the German Cockroaches had disappeared. What had become of them was unknown; but some observations on "The Migration of Cockroaches," by Dr. L. O. Howard (Entomologist of the U.S.A. Board of Agriculture), suggest that they may have possibly removed themselves elsewhere; but whether this was so or not, Dr. Howard's note throws an important light on the reasons of occasionally unaccountable intrusion of this visitation.

In the instance recorded, vast numbers of these "Croton Bugs" were watched by Dr. Howard, Mr. P. H. Dorsett (one of the Department of Agriculture staff), and many others, making their way from the back of an old restaurant near the Department grounds at Washington, and trying to effect a lodgment at the opposite house. From this they were kept out with much difficulty, and only by strewing hot ashes along the side walk; the migrants when they could not go forward dividing right and left, and going down the neighbouring areas. On enquiry at the restaurant, it was found no measures had been taken to drive them away, and it was supposed that, as most of the Cockroaches were females carrying their egg-cases still undeposited (see figures 3 and 4, p. 24), they were under the

influence of some instinct prompting them to search for new quarters. The day was particularly dark and drizzly, and, to quote Dr. Howard's words, "The darkness of the day is significant, and there is no reason to suppose that similar migrations do not frequently occur, but undoubtedly, under ordinary circumstances, at night. This is the way that new houses become infested."—(L. O. H.) *

Returning now to observations of English localities of the German Cockroach, Mr. Malcolm Burr, F.E.S., writing to me from Dormans Park, East Grinstead, favoured me with the following notes:—

"German Cockroach.—I have found this species in several of the London restaurants when dining, and have received them from others. Also it is very numerous at Bradford, and I have found it in hotels at Folkestone." [Hastings and Aldershot were also mentioned by Mr. Burr as localities where he had reason to believe them to be present, but had not himself seen them.] "Brunner von Wattenwyl ('Prodromus der Europaischen Orthopteren,' p. 47) says † :—'In Wien kam sie vor 20 Jahren nur vereinzelt vor und ist jetzt allgemein verbreitet, indem sie die *Periplaneta orientalis*, L. verdrängt.' It is a perfectly cosmopolitan species. Although *germanica* has driven out *orientalis* at Vienna, I am informed by Mr. J. W. Carter that at Bradford both these species are very numerous, while *Periplaneta americana*, L., which used to be abundant, has disappeared. At the Zoological Gardens in London, *Periplaneta americana*, L., and *Phyllodromia germanica*, L., are both exceedingly numerous in some of the houses; the keeper's give the large *americana* to some of the animals to eat, *vide* E. M. M. vii. (New Series), p. 278."—(M. B.)

The *Periplaneta americana*, the American Cockroach or Black Beetle, is yet another kind which may need looking after here more than is commonly supposed. This is from an inch and a quarter to an inch and three-quarters in length, the fore body yellowish, with brown mottlings, and the horns exceptionally long, "reaching considerably beyond the tips of the closed wings, which themselves are long and powerful, and when closed reach beyond the tip of the abdomen."

A good detailed description will be found in the work mentioned below, ‡ in which also the wing-cases of the male are said to be much longer than the abdomen, the legs and under side pale, also the upper side of the abdomen at the part nearest the fore body. The

* 'Insect Life' (United States Department of Agriculture), vol. vii. No. 4, p. 349. Washington, 1895.

† "In Vienna previously to twenty years ago they appeared solitarily, now they are everywhere distributed, and consequently have dispossessed the *Periplaneta orientalis*, L."—(Trans. E. A. O.)

‡ 'The Blattariæ of Australia and Polynesia,' by J. G. O. Tepper, F.L.S., &c.

greater size of this species distinguishes it readily from both of the previously mentioned kinds and "*our own*" Black Beetle, so to call it; and the distinctions of the *Blatta orientalis* being pitchy-coloured *without* markings; the small German Cockroach, *P. germanica*, being yellowish, with two dark *stripes;* and the American Cockroach, *P. americana*, being much larger than either, and with the yellowish fore body with brown *mottlings*, or two large somewhat rusty *spots*, appear to be sufficiently clear for general purposes.

The American Cockroach is stated to be found on "all continents," and for those who wish to follow up its destructive habits, the observations in 'Insect Life,' before quoted from, which can easily be run up by reference to the excellent recently published 'Index,' will give usefully interesting information.

I have not as yet had specimens sent me, but from enquiries made from time to time, I conjecture that this American Cockroach is present in London, besides its establishment at the Zoological Gardens, and that therefore it may be worth while just to draw attention to it.

Prevention and Remedies.—The remedy most approved of by the late Prof. C. V. Riley was fresh and "reliable" Pyrethrum or Persian insect powder. This to be applied by "puffing" it with a little hand machine into all crevices, drawers, cracks of old furniture, behind skirtings, everywhere, in fact, where the insects hide, and next morning clearing away all the dead or stupified Cockroaches that are lying about, and destroying them.

Various other insect powders, as Keating's, for instance, do good, if thoroughly applied; but the great point, which is very apt to be neglected, is the after treatment. Many of the Cockroaches will be only stupified, and if merely thrown aside to a dust-heap, will revive, and be perfectly able to fly or walk back, as the case may be, and re-establish themselves in their old home or in the neighbourhood.

Traps sometimes answer well, and a very simple and convenient plan is to set a small bowl on the floor, with some beer, or beer and sugar, at the bottom, and a few little pieces of stick arranged round, resting on the bowl at their upper ends, so as to form roads for the Cockroaches from the floor. The insects fall or crawl down into the beer, and are drowned or stupified, and if care is taken to throw the bodies into the fire, this simple method sometimes gets rid of a good many.

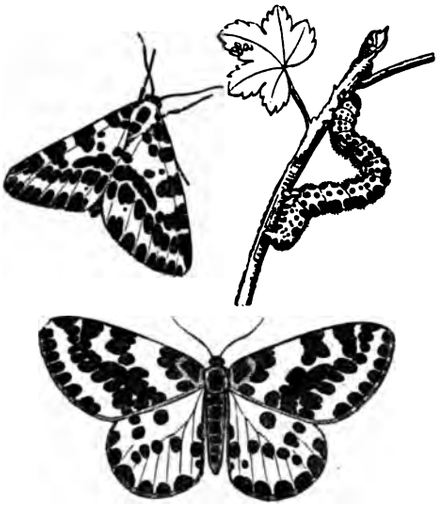
Filling up all chinks and crannies where the Cockroaches may harbour, or through which they may pass to and fro, is a very important item in treatment. If something distasteful is mixed with the plaster of Paris or rougher plaster used, it is a great safeguard against the insects gnawing their way through. Carbolic acid mixed with

lime-wash has been found useful for an application to walls, and probably carbolic acid might be very serviceably applied to prevent the Cockroaches making lodgments, or travelling through chinks, &c., into which the acid could be poured.

Sulphur fumigation is of great use where the attack is on such a large scale as to make the great trouble which is necessary to carry out this plan serviceably worth while; but of these various methods of dealing with the pests I have given details in my 'Twentieth Annual Report,' therefore do not offer them again. But *the* thing of all others that needs attention in order to clear out Cockroaches effectually, is that after they have been stupified or *apparently* killed, the fact should be *made sure of*.

CURRANT.

Currant and Gooseberry Moth; Magpie Moth. *Abraxas grossulariata*, Stephens.



ABRAXAS GROSSULARIATA.—Moth at rest, and with wings spread; caterpillar walking.

This pretty butterfly-like moth, known from the peculiarity of the markings on the wings as the Magpie, and also as the Harlequin Moth, is one of our most widely distributed garden leafage infestations, as it is to be found from the Orkney Islands at the north of Scotland to Kent and Devonshire in the south of England.

Amongst notes of Scottish localities, observations have been sent me from time to time of the caterpillars being found on Red and White Currant and also on Gooseberry leafage at Kirkwall Gardens, in Orkney; also at Dunrobin Castle, in Sutherlandshire, in the north of Scotland. On Black Currants at Portallock, in Argyllshire. On Black, Red, and White Currant and also on Gooseberry leafage at Colinsburgh, Fife. On Gooseberry and Currant also at Dalkeith Gardens, near Edinburgh, and at Oxenford Castle, in Midlothian.

In England it has been reported from Scotswood-on-Tyne, Northumberland, and from other localities too numerous to name, showing the distribution of the insect over a large part of England. But, though occurring in Cheshire and Herefordshire, observations of injuries from the attack have not been sent from the Welsh counties; nor have I had observations sent from more than one locality of its presence in Ireland.

The common garden food-plants of the caterpillars are, as mentioned above, Red and White, and sometimes Black Currants, and Gooseberry, and the leafage of Apricot and Plum is also sometimes attacked. The leafage of the Blackthorn or "Sloe" (*Prunus spinosa*, L.) is also a favourite food.

In the past season the prevalence of this moth was so very observable that it was noticed as follows in the article on "Agriculture" in the 'Times' of Monday, July 26th, 1897 :—

"Last week witnessed the sudden appearance of large numbers of the prettily-marked and readily recognizable Magpie Moth, *Abraxas grossulariata*, the invasion serving to call to mind the similar one of twelve years ago. This moth breeds a looper caterpillar, the colour markings of which are identical with those of its parent; it is a destructive pest of Gooseberry, Currant, and other fruit trees."

To the above Dr. W. Fream, writing from Downton, near Salisbury, on October 30th, in reply to my enquiries, kindly added regarding this attack :—

"It was exceedingly abundant locally, say South Wilts and South Hants, and I also had information from other districts."—(W. F.)

Early in the season I noticed some presence of the moths in my own garden at St. Albans, where I had not previously observed this infestation; and on April 21st the following note of the presence of the attack to a very injurious amount for several years back was sent me by Mr. T. W. Backhouse, of West Hendon House, Sunderland.

Mr. Backhouse observed that he wrote because he did not find I had mentioned in my Annual Report for 1896 "the pest of 'Currant Moths,' alias common 'Magpie Moths,' which has prevailed for some years—I think, four or five—in our neighbourhood. All attempts to overcome them have been more or less unsuccessful, excepting the

extreme measure which has been adopted in some gardens of destroying every Gooseberry and Currant bush that was not already destroyed by the caterpillars, and beginning with a fresh stock. We have not adopted that extreme course ourselves, but are told we shall be obliged to. The caterpillars were certainly worse last year than ever."—(T. W. B.)

This infestation has certainly a power of doing a great deal of mischief, but yet it may quite be hoped that preventive measures, based on knowledge of the habits of the insect, would be successful in clearing out the attack.

The duration of the whole life of the insect,—that is, the time included in the egg condition in summer, subsequent caterpillar state in autumn, winter, and following spring, and chrysalis, from which the moth comes out towards midsummer,—is about a year.

The eggs are laid, one or more as the case may be, on the leaves of the attacked plants, "not only in the evening, but even in the middle of a warm summer's day." * These soon hatch, and the caterpillars may be found in August and September, and feed for a while, but, it is stated, rarely longer than for four weeks. Before winter, they prepare a shelter by spinning the sides of leaves together, in which they may rest, and also spinning the leaf fast to the twig, so that when it fades, the caterpillar still hangs securely in the hung-up leaf, but in some cases the caterpillars merely drop down and shelter themselves in the fallen leaves below the bushes. In these situations they pass the winter, but with the appearance of the leaves in the following spring they come out again, and feed on leafage until some time during May, or towards the beginning of June. Then they spin their light transparent cocoons attached to twigs, or palings, or in crevices of walls, or possibly on the ground, from which the moth comes out towards the middle of summer.

The chrysalis is at first yellow, but soon changes to black, with yellow bands.

The caterpillar is commonly of a creamy or yellowish colour, with a reddish line along each side below the spiracles or breathing-pores, and has a large number of variously sized black spots on the upper part, a black head, and the three pairs of claw-legs are also black. The colouring, however, sometimes varies in amount of black marking, even to being entirely black, without any mixture of yellow or other colour.†

These caterpillars are what are called "loopers" (see figure, p. 28). They have only one pair of sucker-feet besides the three pairs of

* Newman's 'British Moths,' p. 99.

† See 'Larvæ of British Butterflies and Moths' (Ray Society), vol. vii. pt. i. p. 151.

claw-feet beneath the body, consequently, as they have to move these sucker-feet close up to the others in order to steady themselves in progression, they form an upright "loop" in walking, and by this habit, and by their yellowish colouring, blotched with black, they are easily distinguishable from the almost more destructive caterpillars of the Currant and Gooseberry Sawfly, often occurring in company with them. These have a dull pale or bluish green ground colour, with first and second segments partly orange, and those near the tail also orange, and the body sprinkled with black tubercles, each bearing one or more hairs, until the last moult, when the black tubercles are cast off. The above differences in colour, and the circumstance of the larva having six pairs of sucker-feet beneath the body, instead of only one pair (as with the larva of the Magpie Moth), are very easy methods for distinguishing these two infestations.

The Magpie Moth is variable in colouring, but when regular in its marking is easily known. Commonly it has a black head, yellow body between the wings, with a large black spot in the middle; the abdomen also yellow, with five rows of black spots. The wings are white, spotted with black, and the fore wings have a yellow blotch at the base and a yellow band across them. There are, however, almost endless varieties of markings, from black of different shades to white; some have the upper half of the wing white and the lower black, or the reverse; some have the ground colour of the wing (instead of merely a band) yellow; and in some cases the hinder wings are striped with black. It is noteworthy, however, that, as recorded by Mr. Robson, the black variety of larvæ observed by him near Newcastle-on-Tyne only produced the common form, not the especially black marked varieties of the moth. (See reference to black larvæ, p. 30.)

Prevention and Remedies.—The habit of the caterpillar of wintering in spun-together leaves still hanging on the bushes, or sometimes lying amongst any shelter on the ground beneath, is the special habit to be acted on to get rid of it thoroughly. At pruning time the bushes should be very carefully gone over, and also examined afterwards to be sure that there are no leaves which may hold a caterpillar in the spun-together fold left on the bushes. Also, where the bushes have several stems so placed that infested leaves or insect vermin might lodge, it is particularly desirable that such lurking-places should be cleared out, or some trustworthy insecticide poured in. Where Currant bushes are trained on walls, search is especially requisite. It should also be borne in mind that the longer the pruning can be deferred, the more sure it is, to be a good remedy. If the caterpillars have either not become thoroughly torpid, or the weather is sufficiently open for them to re-establish themselves, many will escape by creeping away,

and sheltering again at the surface of the ground. This precaution applies also to date of dressing away possibly infested rubbish from beneath the bushes, which, as well as pruning, is a very desirable preventive. All the prunings and clearings from beneath the bushes should be collected and burnt, in order to avoid any chance of the caterpillars, which would otherwise survive in them till spring, then coming out and crawling back to the bushes.

I have had notes from localities where caterpillar attack was *customarily* bad, and as far as I could judge, it was the *non*-complete removal of the infestation consequently on the early autumn pruning and dressing of the ground beneath the bushes which was the reason. But if the bushes and the ground beneath are properly cleared, respectively by pruning and removal of hanging leaves, and by removal of *surface* shelter below, the pests are *so absolutely cleared out* that there is nothing left to continue attack in the spring.

Removal of the transparent cocoons from any places, as palings, walls, crevices, or boughs, towards the end of May or beginning of June would of course be very desirable, for thus we should get rid of the coming brood of moths; but when the leafage on bushes and walls is in full early summer luxuriance, it is not likely the cocoons will be noticeable unless the infestation is to a quite unusual amount.

Amongst mechanical remedies, hand-picking, if the attack is taken in time, and a good number of workers put on so as to carry through the clearance at once where the Currant or Gooseberry growing is on a large scale, has been found to answer well. Also (as a preventive), where this conspicuous moth is seen in large numbers, it would be worth while, and quite possible from its day flying and quiet habits, to lessen its numbers greatly by use of a common butterfly-net, or sometimes even with the hand.

Placing pieces of canvas or sheets below the bushes, and shaking or jarring the boughs sharply so as to dislodge the caterpillars, and then gathering them up in the cloths and destroying them, has been found good treatment.

For dustings or sprayings, powdered hellebore is one kind of effective application so far as killing the caterpillars is concerned; but it is so very poisonous, and the effect would be so dangerous to all who partook of the fruit, unless it had been washed quite free from the dressing, that I cannot take upon myself to advise it.

Flour of sulphur dusted on the leaves *when the dew is on* so that the powder would adhere, or a liberal application of soot similarly used, are serviceable remedies and quite safe.

Paris-green sprayings, though these to succeed properly should be in such minute quantity of the arsenite contained that they would be (demonstrably) perfectly without any cause of risk to the consumers of

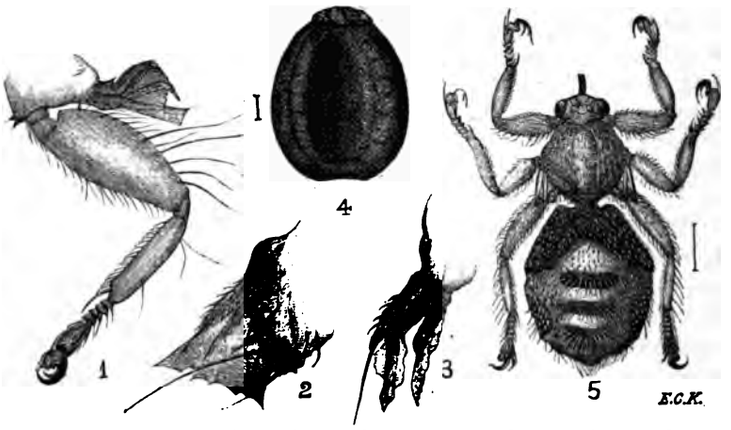
the fruit, yet might raise a prejudice against it injurious to the seller; but the well-known "kerosine emulsion" would do much good without danger, and the "anti-pest" of Messrs. Morris, Little & Son, of Doncaster, which is almost the same as the kerosine emulsion of the United States of America in constituents, but is sold ready mixed in a semi-fluid state at a very cheap rate, would probably save much trouble and damage, from (respectively) the difficulty there usually is in mixing the "emulsion" so that the kerosine and soft-soap wash may unite permanently in the operation of mixing, and the great harm to the leafage in case the mineral oil separates, so that the kerosine (or paraffin) remains undiluted on one part of the leaves, and the soft-soap remains, not doing all the good that it was meant to do, on the other.

The following observation, with which I was favoured by Mr. S. L. Mosley, F.E.S., of the Beaumont Park Museum, Huddersfield, is of practical interest as to one branch of ornithological *non*-assistance in the matter! After mentioning that he had seen this infestation commonly in Cambridgeshire, Lincolnshire, Notts, and parts of Yorkshire, and also had notes of its extreme abundance near Bradford, Ilkley, Pickering, &c., Mr. Mosley added:—

"In some places where Magpie grubs have been abundant, I know that sparrows are plentiful, so it is clear they do not take them—at least, if they do, not to any great extent."—(S. L. M.)

DEER.

Deer Forest Fly. *Lipoptena cervi*, Nitzsch; *Lipoptera cervi*, Von Siebold and Loew.

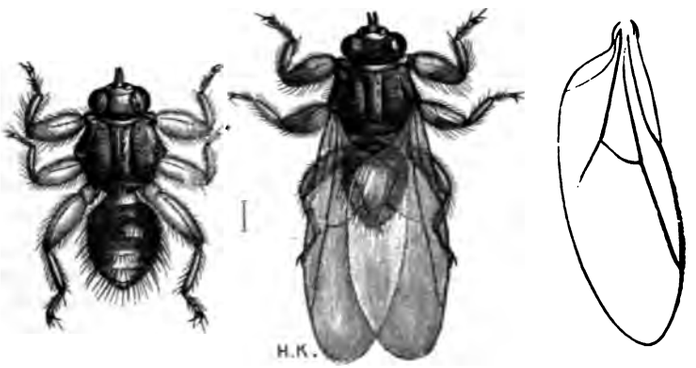


LIPOPTERA CERVI, female.—1, leg and base of wing; 2, base of wing; 3, abortive wing; 5, female fly, with base of wings—all much magnified; 4, puparium, much magnified, and line showing natural length.

The Deer Forest Fly is a much lesser evil than the allied kind, the *Hippobosca equina*, the Forest Fly of the New Forest, as it does not (like this kind) infest cattle and horses, the latter especially, to their intense terror until they become accustomed to the visitation, and also to the great risk under these circumstances of their riders and drivers. Still the *Lipoptera cervi*, or "Deer Bugs," as they are sometimes called, are to be found in numbers of hundreds, or in clusters, on the Red and the Roe Deer, and though their blood-sucking powers do not appear to be to an important extent, they cause great annoyance by the speed with which they can run in any direction amongst the hair, and the tenacity with which they can attach themselves; also those in winged condition cause much annoyance to people walking through woods or localities infested with them in the later part of the summer.

During 1896 I was enabled, through the kind assistance of Mr. Dugald Campbell, of Strathconan Forest, Muir of Ord, Ross-shire, N.B., to give some information regarding the habits of these flies from notes which he favoured me with from his personal observations, and also from specimens sent accompanying, and which, with the addition of various important points in the history of the infestation taken from the published accounts of the chief German writers on the subject, make it unnecessary to go over these details again here.

But in the past season I had hoped to add something on the amount of wings possessed by the female fly,—an interesting subject which has long attracted attention with regard to whether she developed from the pupa-case without them, or shed them, or whether there were modifications of structure or partial removal.



LIPOPTERA CERVI, male, with the wings thrown off; also still retaining wings; line showing natural length; and wing, also much magnified.

In the case of the male of this *L. cervi*, it is developed with wings (see figure above) remarkable for their length compared to that of the body of the fly, but it has the power of dropping the wings,—shedding them off or getting rid of them entirely in some way when the fly settles on a Deer, or what it considers (so to say) may serve for a "host" animal. In my own observations of specimens sent me, I have found so many instances in which the absence of a great part of the wing was caused evidently by the piece having been torn away, leaving perhaps as much as an eighth or more attached to the body, that it appeared to me that this partial removal had very likely been done by means of their flat curved claws, which, if the sides with transverse furrows were pressed together, would be admirably suited to the work.

The history of this *L. cervi* given shortly is that it is one of the division of the *Pupipara*, that is, it multiplies not by depositing an egg, or anything like a maggot or larva with the power of moving or feeding, but a kind of chrysalis-case or *puparium*, in which the forming insect comes to maturity, and emerges as a perfect fly.

In regard to the special kind under consideration, it is found on the Red and Roe Deer, and on the Continent of Europe also on the Elk, whence one of its synonyms, that of *Alcephagus pallidus* of Gimmerthal. Some of the other names under which this species has been distinguished by various entomologists according to the especial peculiarity which he observed, or the animal on which he studied it,

are *Pediculus cervi*, Linnæus (1761), *Ornithobia pallida* and *Melophagus cervi*, Meigen, and *Hæmobora pallipes*, Curtis.

The fly may be generally described as flat, and of a horny texture, with the two wings, when present, laid flat on the back, overlapping at the edges, and projecting very much beyond the end of the tail (see figure, p. 35), and it is about a sixth of an inch in length from head to tail, consequently smaller than our common Forest Fly (*H. equina*), which is about a quarter of an inch in length.

The general colouring is of a horny brown or yellow; the head yellowish, with the top of the head and the mouth parts brown. Thorax flat, chiefly brown, with small bristly warts. Abdomen yellowish or brown, or brown and grey above in the female, covered with minute warts bearing bristles, and variable in shape,—small in the males, somewhat cylindrical or inclining to be conical; larger at the extremity in the females. Legs chiefly yellow; thighs short and thick; legs hairy; claws black, long, curved, and horny, each with a somewhat thumb-shaped much shorter claw at its base, and the curved claws having transverse furrows on the sides, and saw edges, as in the case of *H. equina*.*

In my 'Twentieth Annual Report' I have given detailed descriptions of the habits and appearance and other points so far as seemed serviceable for practical use in regard to this *L. cervi*, with such full references to the works of special writers on the infestation, as Professors Von Siebold, Nitzsch, Loew, &c., that, as this paper is only meant as a record of such amount of information as I have been able to gain in the past season regarding wings of the female as observable on British specimens, I have not repeated the matter or references; but for those who wish to go into the history of this *L. cervi*, as given by different observers under different synonyms, the list of publications given in Dr. Rudolph Schiner's 'Fauna Austriaca (Die Fliegen),' ii. Theil, p. 649, will be found useful.

The following notes refer to the North British observations and specimens sent me in the past year.

On February 9th, Mr. Campbell, writing from Strathconan, sent me the following observation of the great amount of the infestation which he had observed present in the case of a Roe Deer in noticeably bad health. After some general remarks, Mr. Campbell remarked:—

"To-day, however, I have happened to fall in with a Roe Deer which looked the picture of misery, and which I shot out of pity. I

* For figures of the foot of *Hippobosca equina*, with bristle-like central appendage, &c., much magnified, see my 'Nineteenth Annual Report,' p. 99; and for full details see the two accompanying plates, in which the foot and its apparatus is given as seen from above and sideways, magnified to a size of about seven by three to four inches.

found this poor brute to have rubbed the hair off both its sides as bare as to show the bare skin. No doubt this happened in its endeavour to get rid of those pests the 'Forest Fly,' which I found in clusters in the thickest part of what remained of the hair; they evidently collected there (about the chest) having no shelter on the other parts of the poor brute's body in this cold weather, being almost quite hairless. Thus it can be seen how those brutes suffer, not only from the ravages of these pests, but as well from exposure."

With a piece of the Roe Deer skin, sent accompanying, was also a consignment of the Forest Flies.

With regard to annoyance and some amount of injury caused by the Forest Fly to Deer, Mr. Campbell wrote me on March 27th as follows:—

"There are some of the opinion that the 'Forest Fly' does not annoy the Deer when once they get used to them. I cannot believe but they are a source of great annoyance to them. I often see stags and hinds with the hair on neck and sides about this time of the year nearly all broken, so much so, that the skin is nearly exposed in some cases. They are seldom found on Deer that habitually keep the open ground; only those that live in the woods I have noticed as afflicted with them."—(D. C.)

About a week later, on April 2nd, Mr. Campbell sent me a Roebuck's skin, also from Strathconan Forest, Ross-shire, for purposes of examination. This proved to be of a beautiful deep fur, healthy, and very clean from any infestation, excepting a few of the Deer Forest Flies, so few that by careful examination, even by combing and shaking, I only secured about twelve of the *L. cervi*,—some alive, some dead; nor on this skin did I find any puparia loose amongst the hair.

All these Forest Flies, which I examined, appeared to be females. The colour of the head, thorax above and below, and of the legs was of various shades of pitchy. The abdomen pale grey below, commonly only "scalloped" or marked with patches of brown along the outer edges and at the base with a cross-band of the same near the apex; in one specimen these side bands were absent. On the upper side the abdomen had a grey ground colour, marked across at the base with pitchy, this pitchy colour extending about a third along each side, and altogether forming a kind of broad made V-shaped marking, with the points directed backwards (see figure 5, p. 34). Along the upper side of the abdomen were three narrow brown cross-bands,—the band or patch above the caudal extremity being darker in colour and wider than the other two.

In the course of examination I noticed that the abdomen of one specimen was black in colour and distended, and was hard to the touch, and on opening this very carefully, I found within a black

puparium, completely filling the abdominal cavity, so that the external coating was a mere skin. This I carefully rolled back, and gradually detached, injuring it as little as possible, until by pressure I was able to completely disengage the puparium, and on comparing the markings of the specimen, thus clearly proved to be a female, with most of those sent me together with it on April 2nd on the Roebuck's skin, there was no difference to be found.

On examining this specimen from which I had removed the puparium under a one-inch object-glass, I found that it possessed abortive wings, or remains of the lowest portions of the wings from which all but a small quantity of the base (so small as to be almost invisible to the naked eye) had by some means been removed. Another of the specimens also appeared, from the dark colour and distended state of the abdomen, to contain a puparium. These specimens and others of the same consignment which I examined had abortive wings or remains of wings, as above described. In all cases where I was able to get a good view there was membrane with longitudinal veinings.

As I was desirous to be perfectly certain that the specimens (independently of course of the one in which I found the puparium) were females of the *L. cervi*, I ventured to send samples to Prof. Jos. Mik, of Vienna, who was good enough to give me in reply much valuable information, from which I extract the following points:—

"All the specimens you send me are quite certainly females, and fully developed ripe females."

With regard to the black puparium which I forwarded, Prof. Mik observed:—

"The puparium is interesting to me because I possess one which is reddish white, not chitinous (like a larva), but has at the hinder pole a chitinous black shining plate. My puparium is doubtless immature, and has probably been taken by the huntsman from whom I received it with specimens of the imagos out of the abdomen of a female. I have also opened a female which you sent me, and found a light-coloured puparium with black plate in the abdomen. The black spot lies at that end which is directed towards the posterior portion in the abdomen of the imago. It has to be examined if it is after all the anal pole of the puparium" (J. M.); and here Prof. Mik suggested where to search for technical information.

On re-reading the above on November 4th, it occurred to me that possibly the contents of the only puparium now remaining to me of the specimens sent me by Mr. Campbell early in the year might have developed sufficiently to show the position of the imago. Two specimens had been sent me (either on February 9th or April 2nd—I think at the earlier date) which were then of a full black colour, hard, and

very glossy; of these I unfortunately lost one, but from the other the figure given at 5, p. 34, is taken. The general form was, as will be observed, elongate heart-shaped, or oval, slightly concave at the larger end, and the other bluntly produced, so as to resemble a cap or plate with a few raised markings running from the edge to the centre. The central portion of the side figured was noticeably elevated for most of the length, and on each side of this central swelling, between it and the edges of the puparium, was a row of little pits or depressions (see figure). The other side was flatter, and the little pits not so noticeable.

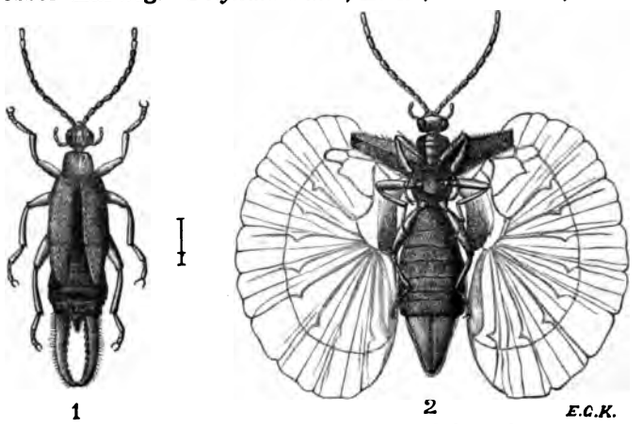
On gently pressing the puparium (on November 4th) it cracked open, and I found the insect within, lying with its head towards the concave end, its tail towards the convex somewhat produced extremity. The eyes were very large, and the wings, which were not as yet inflated, but lying as mere strips one on each side of the fly, reached to about two-thirds the length of the abdomen. The abdomen was shrunk, but from the pointed form of the extremity, as examined under both a two-inch and one-inch focus-glass, it did not seem to me to be open to doubt, although not as yet fully developed, that it was a male.

The above observations, which I merely submit as being such notes of the amount of wing development of the female of *L. cervi* in this country as I have been able to procure to accompany my previous notes of the infestation in the same locality, appear to me to show that in every instance the female had some amount of wing presence. It might be quite abortive, and consisting merely of short distorted veins with a little wing membrane at their sides, or it might be just a short piece of what appeared to be the lowest part of a healthily-formed wing from which the rest had been torn away by some agency removing it by a more or less straight fracture across the wing. In no instance was the female totally without any representation of wing like the male fly when its wings are wholly gone, as figured at p. 35.

If we could procure a supply of puparia and develop the perfect insect, we should of course gain much information on this interesting point. But failing this, it seems to me that if we could but get puparia from the coat of the Deer, or possibly where the Deer had been lying, we might make a great advance by anatomizing them. As the time for the appearance of the fly out of its chrysalis or pupal case drew near (possibly towards the end of June or during July), we might by careful manipulation crack open the case so as to secure the contained imago, and, if fortunate enough to have female specimens, be able to note their condition exactly.

EARWIGS.

Lesser Earwig. *Forficula minor*, Linn.; *Labia minor*, Leach.



LABIA MINOR.—1, male; 2, female with wings expanded, much magnified; line showing natural length of body and forceps.

On April 20th I received, by favour of the editor of 'The Farming World,' specimens of a small kind of Earwig, together with the enquiry:—

"Can your entomologist tell me what sort of insect pest this is, . . . and what would exterminate them from the hot frames where young plants are being struck at present? They seem to come from the manure, are in immense numbers, and actually clear off entirely such young growths as they attack."

On examination, the insects proved to be specimens of the Lesser Earwig, *Forficula minor* of Linnæus, now placed in the genus *Labia* of Leach.

Fully detailed descriptions of the insect will be found in the works referred to below,* and the following notes of the chief characteristics of the insect I have mainly abridged from the description by Fischer.

This is the smallest of the European species; the length of the body only about the fifth of an inch or slightly more; of the nippers or tail-forceps of the male about the twelfth of an inch, of the female rather less. The general colour testaceous, and the insect downy. Head black; horns (antennæ) fuscous, 10–13-jointed, with the lowest joint and those at the extremity often quite pale. Upper part of the body next the head (pronotum) somewhat square, at the hinder part

* Fischer, 'Orthoptera Europæa,' p. 70, 1853; also 'Ortopteros de Espana y Portugal,' por Ignacio Bolivar, pp. 26, 27; Madrid, 1878.

rounded and minutely punctured, the side margins and hinder margins reflexed. The wing-cases (elytra) very finely punctured and truncate at the extremity, with the suture impressed towards the apex (see figure 1, p. 40). The projecting part of the folded wings more than half the length of the wing-cases, and when unfolded of the most beautiful transparent texture and great size (see figure 2, p. 40). The breast and feet pale. The abdomen reddish brown above, black at the sides, pale below; the terminal ventral segment in the male compressed at the hinder part in the middle into a sharp point, much prolonged between the forceps (see figure 1); the arms of the forceps or tail-nippers a little curved, finely serrated along all the inner margin, and the apex incurved. Of the female (see figure 2) the nippers are triangular straight, and bluntly pointed.

In my specimens I found some difference in the colour of the upper part of the abdomen, one of them being, as described above, red-brown with the margins black, and another, as described by Stephens,* with the abdomen reddish, black in the middle; but the smaller size of this species compared to the other European kinds is a very good guide to identification.

On May 10th Mr. Jas. T. Hutchison, to whom I had been indebted for the Scotch specimens, sent me a further supply, with the observation:—

"They have evidently emanated from the manure used for the hot-bed, and do not seem to have made any ravages upon the contents of a 'cold frame' in pretty close proximity to the hot one."

The special love of this "Lesser Earwig" for manure-heaps, as well as for moving in great numbers together, seems to have long been known as characteristic.

In 1841,† John Curtis wrote:—"There is a small species called *Labia minor*, which seems attached to muck-heaps, and sometimes flies in such immense swarms in the sunshine that I was once covered with them in an instant."

Stephens in his observations on this kind (see previous reference) mentions they are "very abundant in the spring throughout the metropolitan district, flying about in gardens and near stables, &c., especially in the vicinity of dung-heaps."

Also so long ago as 1826 ‡ an observation by Mr. Marsham (a well-known entomological writer) is quoted as follows:—Once a little before sunset, observing overhead a number of insects on the wing moving off in one direction, he caught some of them, and they proved

* 'Illustrations of British Entomology,' vol. vi. p. 8.

† See 'Gardeners' Chronicle' for 1841, p. 580.

‡ See Kirby and Spence's 'Introduction to Entomology,' vol. iv. p. 514 of the edition of 1826.

to be *Forficula minor*, L. Struck with the circumstance, he watched them several evenings, and on one of these, as he was looking about a melon-pit for insects, he saw these little creatures alight on the frame, hastily fold up their wings, and entering under the glasses, run down its sides and bury themselves in the loose earth. This he observed repeatedly in September.

As yet no notes have been sent, nor have I been able to find any record of this kind being generally injurious; but their capacity for coming in the swarms mentioned, and clearing off young plants in frames, would make it desirable for garden service to have further information of the habits of this kind, and also of means of prevention.

Earwigs (speaking of the habits of our various kinds together) multiply by laying a number of eggs in a cluster, which it is considered the mother insect watches over with great care, unless from some exceptional circumstance she varies the state of affairs by eating them. The young Earwigs hatch out of the eggs resembling their parents in shape, but without wings or wing-cases,—when the moult to the pupal state occurs, the wing-cases are to be found; and in the case of the Lesser Earwig when the moult to the complete state occurs, it may be known by its comparatively small size, and also by the great amount of projection of the folded wings from beneath the wing-cases. Still, our common kinds of Earwigs look so very much alike, unless examined with the help of a magnifier, that it is very likely this "Lesser Earwig" may often be looked on as the young of the "common" kind, and may be doing special mischief that might be prevented.

So far as observations go, attention to the surface of manure-heaps when of a material or in a condition for egg deposit would be desirable. A little gas-lime sprinkled very thinly over the surface, or gas-water, diluted with about four times the quantity of common water, would do good rather than harm to the manure, and be a great deterrent of egg-laying, also might kill any young and tender Earwigs hatching out within reach of the application.

The applications tried by Mr. Hutchison's gardener as deterrents in the frames, such as Keating's powder, carbolic powder, and even quick-lime, were reported to do no good; but possibly fumigating with tobacco might be beneficial. Also where the method of arrival of this small kind of Earwig has been recorded, it has not been by flying in, but by alighting on the frames, and folding up their wings, and then entering under the glasses. Under these circumstances it would seem as if something greasy or sticky might prevent the creatures making their way onwards. If cart-grease was smeared along the top edge of the outside of the frame and anywhere that it could be serviceably spread without annoyance to the gardeners in moving the lights, it

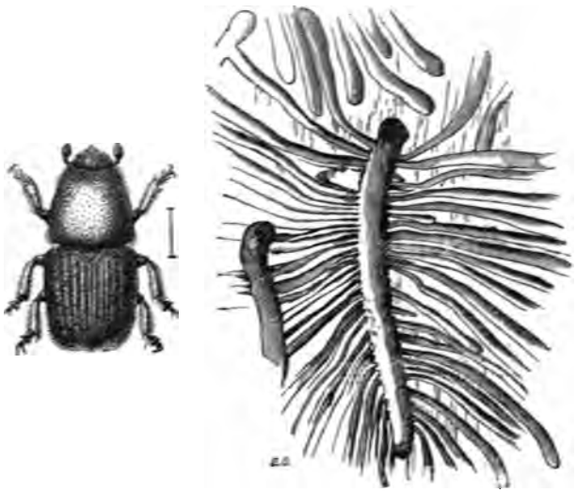
might do a deal of good. Or, if it is the constant habit of the Earwigs to run down the inside of the frames to reach the ground, a band of cart-grease run along inside, or a strip of tarred cloth run along, might catch great numbers, or at least check advance.

In one of his papers on Earwigs, Prof. Westwood mentioned that soaking a bandage in sweet oil was a good method of protection for any special purpose, and if a rough band moistened in some cheap coarse oil answered equally well, this could without difficulty be laid on the ground at the bottom of the inside of the frames.

The common methods of trapping Earwigs are too well known to need comment, but we do not know whether they would act with the somewhat different habits of this "lesser" kind, and a little further study of the infestation when specially seen at its destructive work in frames might give us a good deal of useful knowledge.

ELM.

Elm-bark Beetle. *Scolytus destructor*, Oliv.



SCOLYTUS DESTRUCTOR.—Beetle, much magnified (from 'Forest Protection,' by W. R. Fisher); workings in Elm bark, from life.

The Elm-bark Beetle is one of the very common and very injurious bark-infestations of this country. Quietly, and often without the presence of the mischief being observed (unless by good fortune attention

may chance to be attracted by the number of little perforations like shot-holes in the bark), the injury caused by the tunnellings of the beetles and the successive broods of maggots feeding between the wood and the bark goes on year by year till the passage of the sap can no longer take place, and the bark may be peeled from the wood in sheets of feet or yards in length.

This attack is very liable to spread, and besides its injuries in an economic point of view, it does great harm picturesquely by often attacking fine old Elms in public and private parks or avenues where they can be ill spared. Its history and habits have been thoroughly made out, but as they do not appear so well known generally as is desirable, some notes on the subject may be of service, and I first give just two of the observations which were placed in my hands in the past season, as describing the general appearance of the infested Elm trees. The following are a portion of the remarks with which I was favoured by Mr. John Martin, of Charley Hall, Loughborough, in which it will be seen that the separation of the bark from the tree is particularly noticed:—

"I found in my wood to-day six or eight Elm trees standing dead; on examining them I found the bark falling off, and in the bark a lot of small holes about this size, o. On peeling off some bark, I found between the bark and the tree some white grubs about the size of an ordinary maggot; they appeared to be boring into the tree itself. On some trees the bark had fallen off in long strips. I shall have the trees cut down, and removed as soon as possible. . . . I may say that though there are Oaks and Ashes close to the Elm trees that are damaged, I could not find any that had this grub in them. Also the part of the wood where these trees grow is a somewhat damp and wet part."

The description of the attack left little doubt that it was of the beetle especially known as the "Elm-bark Beetle," scientifically as the *Scolytus destructor;* but in order to be quite sure, Mr. Martin forwarded me, on April 3rd, a box of the injured bark, with specimens of the maggots accompanying, which made the matter quite clear; and on April 7th Mr. Martin wrote:—

"I am having the infested trees cut down to-day, and shall try my best to have the bark, &c., burned, and so to put an end to the pest."—(J. M.)

In the following observation sent me by Mr. Crisp, from the Estate Office, Elton Hall, Peterborough, it will be seen that the ultimate complete separation of the bark from the wood is also mentioned. An enquiry was sent for "the name of a small white grub that is doing much damage to a large Elm tree on this estate; it is nearly a quarter of an inch long, and is in the bark of the tree. The birds are stripping the tree of the bark, and the tree will die. Can anything be done?

A few other trees are slightly attacked. Is there any fear of it spreading?"

The little beetles which cause this serious injury are of the shape figured at p. 43, only about a quarter of an inch or less in length, and less than half that measure in breadth, of a black colour, with the wing-cases, which are square-cornered, reddish or sometimes black or pitchy, the shanks and feet reddish or lighter brown than the beetle, and the horns (antennæ) also reddish or lighter brown, short, slightly elbowed, with the lowest joint long, and the terminal joints forming a club.

The grubs are whitish, curved, fleshy, much wrinkled across, and legless, and have the three first segments swelled in shape, which serves to distinguish them from others of the many parasitic larvæ or other co-tenants of the infested bark.

The attack begins towards the end of May or beginning of June, and though it is considered to be mostly to trees which from some cause are not in full health, yet it may be to the stems of young as well as old, and healthy as well as sickly trees.

The females work their way along the bottom of cracks in the bark, widening them, it is stated, as they go along before beginning their tunnels for egg-laying. These tunnels may be from three to five inches long, and take about three weeks to form. The eggs are laid along each side, and may be above a hundred in number. As the grubs hatch from the eggs, they each start gnawing their tunnels at right angles from the parent gallery,—the size of the tunnel being enlarged to accommodate the increasing size of the larva; so that where there are many eggs laid closely side by side, there very soon ceases to be room for all the grubs, and the tunnels of the strongest and most rapid in working take all the space, and the weaker grubs perish. Many of the grubs are full-fed towards the end of July, and turn to the pupal or chrysalis state at the end of their burrows, and the beetles from these pierce through the bark, and come out from the tree in August, the little shot-hole-like perforations showing where they have escaped.

The greater number of the grubs, however, appear to pass the winter either just within the wood or in the thick bark, and to come out as beetles in May, ready to begin summer attack. It is considered that they prefer a tree which has already been attacked rather than one which is sound and vigorous, and in which consequently the full flow of sap might be prejudicial to the young grubs; and, so far as I have been able to watch the attack myself, I believe that the great proportion of it will be found to be to trees not in their full vigour.

The above remarks give a general description of this very injurious timber infestation, of which it may be remarked in passing that it has

been recorded as occasionally infesting Ash (*Fraxinus excelsior*) as well as Elm; but the attack has been entered on at such length by various writers, that I give at the end of this paper references to some of the published observations.

Prevention and Remedies.—The chief and most simple method in regard to prevention of attack is removal of all centres from which infestation might spread to sound trees; and amongst these most especially is removal of felled or fallen Elm trunks, or boughs from infested trees. These, whilst the bark is still on, contain thousands of maggots, all steadily progressing to beetle state, in which they will fly to start new attack on the neighbouring trees. The grubs will thrive as well beneath the bark of the felled timber, so long as there is moisture enough for them to feed on, as if the trees were still standing; and to this most common practice of non-removal of infested wood is owing a great deal of the constant injury going on to some of the very finest of our park trees. Such neglected trunks may be seen in park land or rural wood yards in all parts of the country where I have had the opportunity of observation; and I have had no difficulty, by merely slipping my hand under the bark, in stripping off feet and yards of it swarming with the Elm-bark maggots in their galleries. Where this can be done nothing further is needed than to strip off the bark and burn it; or if poultry are at hand, and the bark can be thrown with the inner surface uppermost, even the trouble of destroying it is not necessary. The poultry will clear the grubs, and any that fall to the ground will perish. If the bark cannot be run off as above mentioned, infested patches may be easily cleared by rough-shaving off the bark down to the wood; or a good thick coating of pitch or tar applied to the bark would not be costly, and would save much risk of infestation from the beetles which would otherwise come out. To prevent attack of the beetles to standing timber is a very difficult matter. The mixture known as Leinweber's composition, for which the following recipe is given in Dr. Schlich's 'Manual of Forestry,' is said to be useful for this purpose:—"5 lb. of tobacco, mixed with half a pailful of hot water, are kept hot for twenty-four hours; the water is then squeezed out of the tobacco, and mixed with half a pailful of bullock's blood, one part of slaked lime, and sixteen parts of cow-dung. This is kept in an open tub, and stirred once a day, and used after fermentation has set in. The rough bark, moss, &c., is trimmed off the tree, and the latter painted with the mixture for three successive days until a crust is formed, which the rain will not wash off."* But besides the very disgusting nature of the appli-

* 'Forest Protection,' by W. R. Fisher, p. 250, being vol. iv. of Dr. Schlich's 'Manual of Forestry.' London: Bradbury, Agnew & Co., Bouverie Street.

cation, which would be repulsive to the operators, even if not prejudicial to health, there would be difficulty without the use of long ladders in managing to coat the trees with the mixture as high up as is needed.

A less objectionable mixture, known in Canada as the "Saunders' Wash," forms a tenacious coating on the bark, and is found serviceable there as a preventive of "shot-borer" beetle, serving equally to keep the beetles from getting in, or getting out. This is composed of soft-soap reduced to the consistence of a thick paint by the addition of a strong solution of washing-soda in water; and if applied to the bark of the tree during the morning of a warm day, will dry in a few hours, and form a tenacious coating not easily dissolved by rain. In a further communication, which Dr. Fletcher (Entomologist of the Experimental Farms, Department of Agriculture, Ontario, Canada) was good enough to send me on the subject, he mentioned:—"With regard to the soap-wash suggested for *Xyleborus dispar*, I have this year suggested the addition of carbolic acid, which I feel sure will have a good effect." A process was tried with success by our Botanic Society, so far back as the year 1842, which might be serviceable for saving special trees, but would hardly be applicable for work on a large scale. The plan consisted "in divesting the tree of its rough outer bark, being careful at the infested parts to go deep enough to destroy the young larvæ, and dressing with the usual mixture of lime and cow-dung." *

A series of French experiments based on the plan sometimes used of paring off the outer bark to restore vigour to bark-bound apple trees, and also on observations that where a vigorous flow of sap was brought about under Elm bark that many of the bark maggots were killed, were instituted as to the effect of having the whole of the rough outer bark of the Elm cut or shaved away. This operation caused a great flow of sap in the inner lining of the bark, and the grubs of the *Scolytus* beetle were found in all cases to perish shortly afterwards. Whether this occurred from the altered sap disagreeing with them, or from the greater amount of moisture round them, or from the maggots being more exposed to atmospheric changes, or any other cause, was not ascertained; but the trees that were experimented on were cleared of the maggots. The treatment was applied on a large scale, especially on Elms infested by *Scolyti* along the Avenue of Neuilly, the Boulevards, the Quai d'Orsay, &c., Paris, and the barked trees were found, after examination by the Commissioners of the Institute at two different periods, to be in more vigorous health than the neighbouring ones of which the bark was untouched. More than two thousand Elms were thus treated.†

* Details, with illustrations, were given in a paper read in 1848 before the Botanic Society.

† The above account is abridged from the leading article in the 'Gardeners' Chronicle and Agricultural Gazette' for April 29th, 1848.

But whatever plans may be tried for prevention of attack or ameliorating injury, the great point of all, which needs careful attention, is that infested Elm timber should not be permitted to lie about to breed beetles by thousands to fly abroad and re-infest the whole neighbourhood.

Serviceable information regarding this infestation will be found in the following publications :—

"Forest Protection," by W. R. Fisher, B.A.; being vol. iv. of Schlich's 'Manual of Forestry.' London: Bradbury, Agnew & Co.

A paper by Dr. Chapman, published in the 'Entomologists' Monthly Magazine' for 1869, p. 126. London: Messrs. Gurney & Jackson, Paternoster Row, E.C.

'Praktische Insektenkunde,' von Dr. E. L. Taschenberg, pt. ii. p. 240. Bremen.

'Die Europäischen Borkenkäfer,' von W. Eichhoff, p. 148. Berlin.

LADY-BIRD BEETLES.

Seven-spotted Lady-bird. *Coccinella septempunctata*, Linn.; and other species.

COCCINELLÆ.—1, cluster of eggs; 2, egg, magnified; 3, larva, magnified; 4, line showing nat. length; pupæ; 7, Two-spotted Lady-bird; 8, variety of same species; 9, Seven-spotted Lady-bird.

The Lady-bird Beetles, and their slaty-grey, six-legged, and yellow-and-scarlet spotted grubs, are well known to all Hop-growers as rendering good service by lessening the numbers of the Hop Green Fly and Lice (scientifically, Hop Aphides) on the bines to a very important amount; but they are not nearly so well known as they ought to be generally as sometimes doing equally good service in connection with common field crops as Turnips, Mangolds, &c., when

there is some especially bad attack of Plant-lice. Consequently the mischief that is being done by the Plant-lice is apt to be attributed to the very insects which are clearing the Plant-lice off, even to the extent of labour and time being given in careful destruction of the Lady-birds.

Last year I had enquiries as to the nature of Lady-bird infestation from widely distant localities, and as it is somewhat of interest to find it present on three distinct kinds of crops, namely, on leafage of Turnips; Mangolds; and also Tares, and Beans, I give the notes as follows.

The following observation was sent me, on July 23rd, from near Grampound, in Cornwall, on the part of a farmer, who, finding his Turnips perishing, and the very noticeable Lady-bird grubs in vast numbers upon the leafage, not unnaturally credited them with the mischief:—

"To-day a farmer showed me the enclosed insects; he has never seen them before. They are in thousands on his Turnips, and are, to use his words, cutting them to pieces. I should like to know what they are, why they come, what they do, and how to get rid of them?"

The accompanying specimens proved to be grubs of one of our large kinds of Lady-bird Beetle, and after a few days, on further communication and development of specimens, the infestation proved to be of larvæ (grubs) and beetles of our very common and handsome Seven-spotted Lady-bird, the *Coccinella septempunctata*.

On Aug. 11th the following note was sent me from a farm in the neighbourhood of Sandy, Bedfordshire:—"I am sending you a fly which I found in my Mangolds to-day; it has already done considerable mischief to them, and perhaps you will kindly tell me what it is."

In this instance the Lady-birds were still in the grub state, and with them were black aphides on the Mangold leaves, showing very plainly what it was that had brought their natural enemies; and a few days later I received the following communication, with larva enclosed, mentioning the presence of the Lady-birds also on the Beans, which, as is unnecessary to say, is a crop particularly liable to infestation of Aphides or Plant-lice. My correspondent observed:—

"I found some Lady-birds on some Beans close to the Mangolds, and I only took the one specimen of the insect I sent to you, as I thought I would wait till hearing from you about it before I did anything. Some of the Mangolds are badly attacked with the aphides, but perhaps some nice showers will wash them off."

On Sept. 4th the following note was sent me by one of my correspondents at Appleby, near Doncaster, which, it will be seen, shows the presence of Lady-birds in myriads as helpers to destroy the aphides on yet another kind of crop to those previously mentioned:—

"I have been on the wolds near Grimsby this week, and the lambs are put on Tares and Rape. The Tares are simply covered with filth, and millions of Lady-birds have come to them. A net-stake was covered, and they are on the gates all over. I never saw so many."

On Sept. 15th my correspondent wrote further, in reply to my letter on the subject:—"I sent at once to the place where I saw the filth on the Tares, but the rains have killed them."

Below I give extract from letter in answer to my enquiry:—

"The aphides on the Tares are all gone, the late heavy rains and colder temperature having killed them. The Lady-birds are to be seen dead in great numbers on the Tares, their *pabulum*, the aphides, having failed them. One of our greatest long-wool ram breeders refused to put his young rams on his Tares, owing to the excessive filth."

The following note by the late well-known coleopterist, Mr. E. C. Rye, is of interest in connection with these vast appearances of Lady-birds:—

"They have been observed in the southern counties to follow the aphis in swarms, unexpectedly making their appearance by thousands, and settling upon every available resting place; indeed, I have known them to occur in such numbers that it has been necessary to sweep them away from paths and windows. They fly strongly, but are not rapid or strong walkers. . . . The patches of small yellow eggs can often be seen deposited by the parent insect on plants infested by aphides; and the slaty-blue larvæ, which are tuberculated and spotted, contracted behind, and with six conspicuous legs in front, may be observed crawling about shrubs in gardens, or on walls, preparatory to the change to pupa, which is fastened by the tail, and does not get rid of the skin of the larva." *

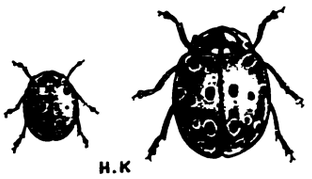
The genus *Coccinella*, to which these beetles belong, does excellent service by destroying Aphides or Plant-lice, both in the beetle state, commonly known as the Lady-bird, and also (and to a still greater extent) in the grub or larval condition, sometimes known as "niggers." The eggs soon hatch, and the grubs feed (on the aphides) for about a fortnight or three weeks; they then change to the chrysalis or pupal state, from which the beetles appear also in about a fortnight or three weeks' time. The late broods pass the winter in beetle state in any convenient shelter, as crevices of palings, under bark, amongst loose leaves, or in buildings, or dwelling-house, and are ready with the return of warm weather to lay eggs and start a new generation.

The *Coccinellæ*, which are more especially known as Lady-birds, are small beetles, hemispherical in shape, convex above and flat below,

* 'British Beetles,' by E. C. Rye, p. 228.

with a short transverse thorax, and short clubbed antennæ. The length varying in different species from hardly a sixth of an inch, as in the case of the pretty little lemon-yellow kind, with twenty-two black spots, to our largest species, the Eyed Lady-bird, which is from a third to nearly half an inch in length.

The two commonest kinds are the Seven-spotted, *Coccinella septempunctata*, and the Two-spotted, *C. bipunctata;* both kinds black, with



COCCINELLA OCELLATA.—Eyed Lady-bird, natural size and magnified.

bright red wing-cases spotted with black in the numbers conveyed by the names, but the *bipunctata* is very subject to variation in colouring.

The Eyed Lady-bird, *C. ocellata*, is a very handsome insect, with black head varied with white markings; thorax (fore body) black, margined with white in front and at each side; the wing-cases reddish, with eight black spots ringed round with pale yellowish colour on each. This kind varies in its markings, and infests Fir and Pine, but Stephens mentions it as also found on Beech; and the specimen figured, which is the only one I have received, was found on a Hop leaf belonging to a white bine (or old "golding") growing in an old hop-yard in the parish of Yalding, Kent, which kind, I was informed, was peculiarly liable to attack of Green Fly.* Anyway, even the passing presence of this great kind of Lady-bird on the Hop is perhaps worth record.

Another kind deserving a word, though not strictly a *Coccinella*, is the Minute Black Lady-bird, the *Scymnus minimus* of Rossi, of which specimens were sent me on August 5th, 1893, from Canon Court, Wateringbury, Kent, by Mr. Edw. Goodwin, as doing good service in grub state by preying on Red Spider on Hops; and it was again noticed to some degree in the following year.

This very little beetle is like the common Lady-birds in shape, but hardly the twelfth of an inch in length, black in colour, with the wing-cases *slightly downy*. The maggots, when fully grown, are hardly the eighth of an inch in length, and, as seen by the naked eye, of a smoky grey colour; with a two-inch focus object-glass they are of a smoky yellowish colour, with black markings. The maggots, as well as the chrysalids, are similar in shape to those of the common Lady-bird.

* See my 'Eighteenth Annual Report on Injurious Insects,' p. 72.

In maggot state these *Scymni* appeared perfectly voracious, and certainly did not confine themselves to Red Spider on the Hop leaves, for, on placing them on Plum leaves infested with Red Spider, they began to feed almost immediately, and continued at the work steadily. Failing other food they devoured each other, in one instance under my observation, until only one survivor remained, which went through its changes rapidly. On August 28th it was still in larval state, and after changing in the usual manner of the Lady-birds to a pupa (in this instance shiny and black), hung up by the tip of the tail, I found, on September 6th, the little Black Lady-bird walking actively about.

From the good supply of specimens sent me, I was able to watch the development of this useful little creature from the larval to the beetle state, and gave the observations in detail in my Seventeenth Annual Report, as I am not aware of the history having been noted previously.

The only method in which artificial measures appear reasonably practicable in gaining help from these various kinds of Lady-bird Beetles and their larvæ is by their appearance being so generally known that when they are observed in the vast numbers in which they come at times to aphis-infested field crops, they may not be *purposely* destroyed as field pests. I have been consulted about them, with the information accompanying that they were being hand-picked as destructive, and, though there is no danger of this happening in the case of Hop fields, in other cases it may save harm to draw attention to their services being beneficial.

As yet (so far as I am aware) we have not any examples of Coccinellid beetles being injurious in this country by feeding on leafage. But various species of Lady-birds of this family, of the genus *Epilachna*, do notable mischief as vegetable feeders. Of these two species are recorded as injurious in the United States—one the *E. borealis*, the other the *E. corrupta*. Both of these are good-sized beetles (the *borealis* in the figure before me is well over a quarter of an inch in length), hemispherical (like our own Lady-birds) in shape, and yellow in colour with black spots.

The larvæ are also yellow, of a long oval in shape, and with long and branched spines. The above characteristics make them perfectly distinguishable, both in beetle and grub state, from our own helpful Lady-birds.

The *Epilachna corrupta* is injurious to Beans, both to leaf and pod; but as it is especially reported as present in the west and south-west of the United States, it seems unlikely that this kind should trouble us here. The other species, the *E. borealis*, is found in the more northerly and easterly States, and attacks the leafage of Cucumber,

Melon, and similar plants;* and as the climate here might allow of its presence, at least as an infestation of plants under glass, a few words of description may be of service.

LOCUSTS.

Migratory Locust of South America. *Acridium* (*Schistocerca*) *paranense*, Burm.

ACRIDIUM (SCHISTOCERCA) AMERICANUM, after Riley, North American Migratory Locust (see p. 54 for likeness to South American species).

On May 28th the following note was sent me by Mr. Geo. Barton, manager to Mr. John Cox, cowkeeper, &c., of 112, 114, and 116, Harris Street, Camberwell, S.E.:—"The enclosed specimens are arriving in bales of hay from South America; would you be so kind as to tell me what they are?"

On examination, the insects proved to be specimens of the "Migratory Locust" of South America, scientifically *Acridium* (*Schistocerca*) *paranense*, Burmeister, the same species of which specimens were sent to me in 1893 from a Liverpool firm, with the enquiry whether the insects, which were found in quantity averaging one Locust to a pound of the Alfalfa (Lucerne) hay which was then (February 2nd) being landed from Buenos Ayres, were injurious to horses or cattle if consumed in fodder.

I was unable to offer any information on this point, and advised procuring a proper veterinary opinion, as, on the face of the thing, it seemed very possible that the hard, horny, and spiny shanks of the hind legs of the Locusts might cause mischief; but I did not hear of illness either in this case or in the case of specimens of the same kind

* 'Economic Entomology,' by John B. Smith, Entomologist o the New Jersey State Board of Agriculture, p. 175. Philadelphia, 1896.

of Locust sent me in the beginning of September in the same year on the part of a farmer in the neighbourhood of Caversham, Oxfordshire, who wrote me that he had just purchased some foreign hay, and found quantities of Locusts in it to the amount of not less than two hundred specimens in one truss. For details, see my 'Seventeenth Annual Report,' pp. 47–53.

In the past season, however, as some illness occurred in consequence of (or, at least, in coincidence with) some horses feeding on Locust-infested fodder, it may be of interest just to mention the circumstance.

On June 2nd Mr. Barton sent me a packet containing one hundred and sixteen Locusts, now shrunk and flattened and out of shape from being closely packed in the Alfalfa, but which, when fresh, would have been about the size of the exceedingly nearly allied, if not identical, species the North American Migratory Locust, the *Acridium* (*Schistocerca*) *americana* of Drury, figured at p. 53, and with these, fragments of other specimens of the same kind, and the following note accompanying:—

"I am sending you specimens promised. The whole are the contents of two bales of Alfalfa of Buenos Ayres, each weighing about 1 cwt.; in some bales there are scarcely any specimens, but in others large quantities. They seem to congregate in swarms."

In regard to horses, Mr. Barton mentioned that the first of the three employed, one evening showed signs of colic and inflammation, and the next morning another horse was attacked; and Mr. Barton observed that he "thought it rather curious, so overhauled the food, and discovered the Locusts; at once changed the hay, substituted bran for a day," and the illness vanished. During this time the third horse was taken ill with exactly the same symptoms. One noticeable feature in the symptoms is that the animal stands with tail straight out, and legs stretched out to the fullest extent, and continually looks round to his flanks. On June 22nd Mr. Barton further mentioned that this horse "was very low for a week, but no doubt bran-mashes and a drench every six hours would account for that, since I have noticed no difference whatsoever; the animal seems quite well."—(G. B.) Mr. Barton mentioned that he was feeding cows with the infested Alfalfa, and could not see that it affected them in the least.

The above observation may possibly be of some interest in connection with the importation of Alfalfa from a country so greatly infested with Locusts as the Argentine districts. I am not able myself to judge, as I in no way understand or study veterinary matters; but having been previously asked whether I knew of illness occurring in connection with consumption of infested fodder, I just

give above the main points of the notes with which Mr. Barton favoured me.

The figure of the North American Migratory Locust at p. 53 gives as good an idea of those of South America as if taken from one of them. The colouring of the specimens sent me was: head mottled, of various tints, including reddish pink; the thorax striped lengthwise above with various shades of yellowish brown and deeper brown, or with deep brown striped with a still deeper shade; hind shanks coral red with white spines, black at the tips. The narrow parchment-like upper wings have a pale narrow stripe at the fore edge, and also for rather more than half the length at the hinder edge, with an area between the two stripes, narrow at the base and gradually widening, marked with angular brown blotches, these dark near the base, and fainter towards the tip of the wing. Beneath these elytra or upper wings are folded a pair of large wings of delicate transparent tissue.

With regard to the precise name of this destructive South American Locust. On first receiving specimens, I forwarded samples to Señor Don Ignacio Bolivar, at Madrid, in order to be absolutely certain on the matter, and he was good enough to examine and confirm my identification, mentioning that it was "without doubt the *Acridium* (or rather the *Schistocerca*) *paranense*, Burm., which causes much ravage in southern parts of America." It may also be of some interest to note that in the First Report of the U.S.A. Entomological Commission it is mentioned that there is so little difference between the *Acridium americanum*, or Migratory Locust of North America, and the *Acridium peregrinum*, the migratory species of South-western Asia and North Africa, that ordinary observation would scarcely find any difference between the two. Also various writers consider that the *Acridium peregrinum* does not really differ from the *A. paranense* of the Argentine Republic; and in published observations placed in my hands during the past season regarding the local investigations of this serious agricultural pest of the Argentine Republic, I notice that the name adopted is *Acridium peregrinum*.

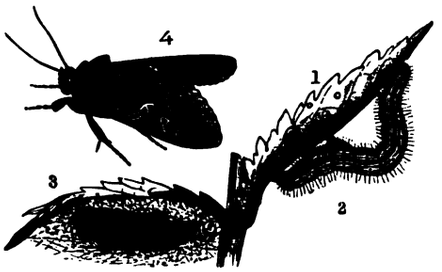
The details of the investigations are not of practical agricultural interest here; but on June 2nd I was favoured by a visit from Mr. Hy. Watts, Secretary of the South American Land Company, and Mr. J. D. Lyon, of the Estancia Trenel, manager of about 120 miles of land about 350 miles west of Buenos Ayres, and Mr. Lyon at once recognized the specimens sent me by Mr. Barton as the same kind which was so exceedingly injurious in his part of the country, where he mentioned that they had now been prevalent for seven years; and to give some idea of the wide area of infestation, he mentioned on one occasion riding through the great swarms or flocks of Locusts for about twenty miles, and a friend continuing the observation for

nineteen miles more, thus showing thirty-nine miles of continuous presence of Locusts.

As, from all observations up to date, it seems to be proved that Locust attack cannot establish itself in this country, it is unnecessary to enter on means of prevention and remedy.

MANGOLD.

Silver Y-Moth. *Plusia gamma*, Linn.



PLUSIA GAMMA.—1, eggs; 2, caterpillar; 3, chrysalis in cocoon; 4, moth.

This pretty moth, which takes both its popular and scientific name from the silver marking in the shape of the English letter Y and the letter in the Greek known as gamma, on the fore wings, is very widely distributed in England, Scotland, and Ireland, and often observable in summer and autumn, sometimes in great numbers, although it is only occasionally that it does much mischief with us.

Last season, however, towards the end of the summer, this infestation did a deal of harm to Mangold leafage at a locality in the County of Kerry, in the extreme south-west of Ireland. Specimens of the cocoons were sent me, from which I found the first moth developed on September 11th; and two days afterwards I was favoured by the following observations from Prof. P. Hedworth Foulkes, of the University Extension College, Reading:—

"I have just returned from a tour in Ireland, and while there came across, in Co. Kerry, a very serious attack on Mangolds of what I now find to be the *Plusia gamma*. . . . We managed to find a few pupæ, which we sent to you. The attack was over, but the damage done was very apparent, and but for the abundant supply of rain I doubt whether there would have been a crop at all. I have never seen anything like it, and I believe I am right in saying that this

insect seldom does any damage in this country. Of course abroad we know that Beet is very liable to severe attack."

On October 1st Prof. Foulkes, at my request, favoured me with a few more observations:—

"The field contained about fifteen acres of Mangolds, and was part of the home farm of Sir John Colomb, two or three miles out of Kenmare; the damage done by the pest would have been more apparent earlier in the season than when seen, *viz.* September 1st, as the August rains had no doubt saved the crop. Prof. Carrol and I estimated the damage then to mean a loss of about fifteen to twenty per cent. of the crop. If the crop had been in a dry district, I should very much doubt there being a crop at all. We found a few caterpillars still feeding, and I have wondered whether these could be a second brood. The pupæ found were enclosed in strong net-work cases on the under side of leaves, and seemed capable of standing excessive moisture. I should be glad to know whether the pupa stage is ever passed below the surface of the soil; I ask this because we searched well the leaves, but only found a few pupæ, nothing like what we expected to find with so much damage. Neither was this due to the (shall I say) lateness, because we should in this case have found the remains of the cocoons upon the leaves."

Prof. Foulkes' enquiry is one of very practical interest, but it does not appear that this moth does pupate under ground. The caterpillars by no means necessarily spin up on their food-plants; they are stated to form their cocoons on "any plant," and we had a good example of this in an observation sent me on October 3rd, 1883, by Mr. Geo. Brown, from Watten Mains, Caithness, N.B., where he had noticed caterpillars, which turned out to be those of the *Plusia gamma*, doing much harm to Turnip leafage. Amongst the specimens sent were some moth chrysalids in web cocoons, with the note: "Corn crops are perfectly covered with these cocoons; beneath the sheath-leaf and stalk in the corn, in the seed-stalks of Sorrel, and on every and all parts of the Field Thistle the cocoons appear"; and a little later on more specimens were sent, which showed the infestation to be of the *P. gamma*, the Silver Y-Moth.

This moth is widely distributed, and often noticeable in summer and autumn flying about flowers in the day-time. The fore wings, which are upwards of an inch and a half in expanse, are of a satiny glance varied with brown and grey markings, and sometimes with a purplish or coppery lustre, and in the centre is the pale or silvery marking like the letter Y, from which the moth takes its name. The body is smoky colour, and so is the ground colour of the hinder wings, but these are sometimes of a whitish colour across the centre, "leaving a broad brown margin; the fringe is whitish, with a line of blackish

spots." Of this moth John Curtis says there are two broods yearly; customarily (according to foreign observation*), the half-grown caterpillars live through the winter, and apparently the moths occasionally do so, as they have been found at the beginning of May. The eggs are generally laid beneath the leaves, singly or in clusters, as the case may be, and soon hatch. The caterpillar, when full grown, is green, covered with short hairs; the head brownish green; six white or pale lines along the back, and a yellow line along each side. It has three pairs of claw-feet, and *two* pairs of sucker-feet or prolegs beneath the body, besides the pair at the end of the tail, which are green and fleshy; and, consequently on having the two pairs of sucker-feet, it is what is called a "half-looper" caterpillar (see figure 2, p. 56). It raises itself in a loop when walking, but not as high and complete a loop as is characteristically formed by caterpillars with only *one* pair of abdominal sucker-feet.

A "probably hitherto undescribed form of the larva" is mentioned by Mr. Geo. Porritt† as having been sent him by Mr. C. Whitehead in July, 1892. These specimens were smaller than the ordinary form, only an inch in length at full growth; the ground colour dark olive green,—in one specimen nearly black; head and prolegs intensely black and shining (for full description see reference). Of these only a moderate proportion (half the number or so) appear to have spun, and of these again a very small proportion of the chrysalids produced the moth, but enough to show that though very small, less than half the size of ordinary specimens, with which they were compared by Mr. Porritt, and also paler in colour, there was nothing to distinguish them from the true *P. gamma*.

When full-fed the caterpillars spin a white woolly cocoon, either in the folds of a leaf or on some plant, and in it they change to a black or pitchy chrysalis (see figure 3, p. 56).

The caterpillars appear to be very general feeders, including in their food-plants leguminous crops, as Peas, Beans of different kinds, and Clover, also Turnip and Cabbage leafage, also Lettuce, Beet, and Mangold leafage, &c., and have also been known to attack Oats. Amongst weeds they have been found to attack Thistles (*Carduus*), Burdock (*Arctium*), Nettles (*Urtica*), and also grasses.

The species appears to be more or less present every year during summer and autumn, and sometimes very abundantly, as, for instance, in 1892, when Mr. Geo. Porritt observed, on September 8th (see reference above), that on the Lancashire coast the moth was flying in thousands a fortnight previously.

* See 'Praktische Insektenkunde,' of Dr. Taschenberg, pt. iii. p. 154.

† See 'Larvæ of British Butterflies and Moths' vol. vi. pt. iii. p. 112. London: Ray Society.

But as a really destructive infestation of our crops it is rarely mentioned, the great exception being the memorable immigration into this country in the year 1879, in which the swarms left North Africa in April, and, after traversing Europe, and doing plentiful mischief by the caterpillar infestation they gave rise to by the way, they arrived on our south coast early in June, and the moths were subsequently observable throughout England, Scotland, and Ireland.* The caterpillars did great mischief in various places; but it is worth notice that, notwithstanding the great prevalence of the infestation in 1879, in the the following year it was merely reported as being noticed in small numbers and in few localities. One very especial example of this was at Exeter, where, in 1879, Mr. Edw. Parfitt (who was a skilled entomologist) mentioned that he "never saw anything to be compared with its numbers; towards the end of September the larvæ literally swarmed on every garden plant, defoliating the plants, as well as riddling the leaves"; and in the following year Mr. Parfitt observed that up to the 17th of September not a single specimen had been seen in the neighbourhood of Exeter.

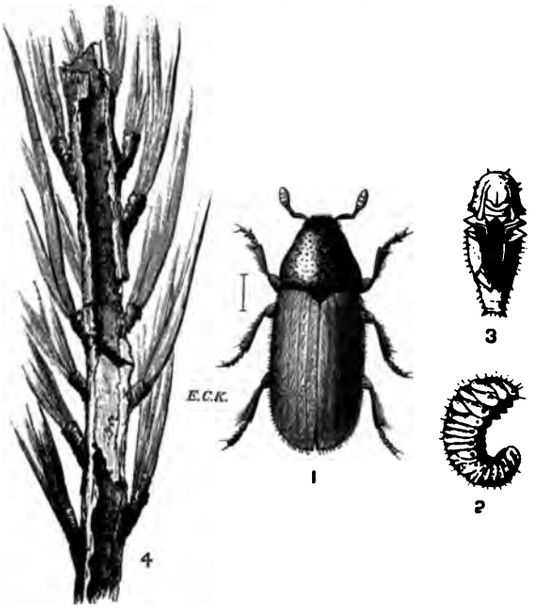
Prevention and Remedy.—As this attack so rarely occurs, measures of preventing it seem hardly to require to be entered on. Still it would perhaps be desirable where cocoons are noticed in the great numbers mentioned at p. 57, to have these collected and burnt. This small amount of trouble would ensure that there should be no recurrence of attack, in whatever state the infestation may pass the winter with us, from development of the contained chrysalids.

In garden attack, dustings with lime and the customary deterrent dressings would be sure to be beneficial; and as the caterpillars are large, hand-picking might be a very serviceable remedy at no great cost; also, as the caterpillars appear very sensitive to the effects of wet, heavy washings or syringings of cold water would be likely to get rid of many of them.

* For many details and dates of observation, for which I was obliged to Mr. E. A. Fitch, F.E.S., of Maldon, Essex, see, amongst other contemporary records, my own Annual Report for 1879.

PINE.

Pine Beetle. *Hylurgus piniperda*, Linn.



HYLURGUS PINIPERDA.—1, beetle; 2, larva; 3, pupa,—all magnified, with line showing natural length of beetle; 4, Pine shoot tunnelled by beetles.

In 1896, attention was very forcibly drawn by various correspondents to the serious amount of injury which was being caused by the "Pine Beetle" in various districts in Scotland, notably in parts of Forfarshire, and in the neighbourhood of Montrose, and likewise (in England) near Redditch, Warwickshire; this great presence of the pest being especially noticeable where Scotch Fir was blown over by the gales of recent years, and (often almost unavoidably) allowed to lie where it fell. These blown-over or injured trees, or the boughs thrown down by the gales, become the breeding-ground of the Pine Beetles, which propagate, and continue by successive broods to propagate yearly, between the bark and wood of the trees or boughs, in which the full flow of sap is thus checked, until it has become too dead and dry to afford sufficiently juicy food for the multitudes of growing maggots.

The observations sent regarding the widely spread and great amount of presence of this timber pest in 1896 in absolute sequence

with the occurrence of great gales of very recent years were of much practical interest as confirming on a very broad scale the principle laid down in all good forest practice, that, to prevent infestation of Pine Beetles, their nursery-grounds should not be allowed to exist.

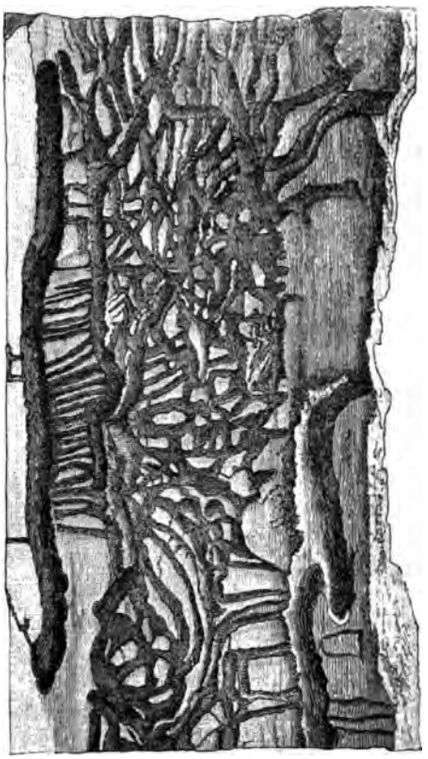
But in the past season, such special further observation has been made of injury by Pine Beetle attack occurring over a large area in connection with many thousands of trees being blown down by the gales of 1893 and 1894 that the subject is worth reference to again as showing how the effects of these great gales not only cause present loss of much timber, but, if not attended to, lay the foundation of a successive yearly destruction to a very serious amount.

The worst attack, it will be seen, was on the great Haddo House property near Aberdeen, on which Mr. J. Clark (forester) is purposing to set on foot carefully considered measures to check the progress of the infestation; but to those not fully acquainted with the Pine Beetle and its life-history, the following short account may usefully precede Mr. Clark's notes, to show the reasons of his proposed operations.

Mother beetle and larval galleries.

The damage done by the beetles to the shoots of the Pines, and the numbers of these which are found on the ground beneath the Fir trees, or perishing upon them consequently on the central part having been tunnelled away for some inches in length by the beetles, is what usually draws attention to the presence of the attack. But it is not in these burrows that the beetle lays its eggs and the maggots feed. The regular course of operations is for the beetles to appear in April and May, and the females then bore their galleries by piercing a little hole through the bark of boughs, or young trees lately felled, wind-fallen timber, &c., and there each female gnaws a tunnel just below

the bark, and lays her eggs along each side of it. The maggots soon hatch, and each maggot gnaws its own tunnel somewhat at right angles to the mother gallery (see figure, p. 61), and when full fed, which is towards July or August, they turn to pupæ at the end of their galleries beneath (or in) the bark, where the beetles complete their development, bore through the bark, thus causing the shot-like holes so observable in bark of infested trees, and then fly to growing shoots,



Inside of Pine bark, showing tunnelling of Pine Beetle and maggot.

which they tunnel and destroy, but only use as shelter, not for places of egg deposit. The beetles come out from the timber about the middle of the summer, it may be from the end of June until the end of August.

The larva or maggot of the Pine Beetle (*H. piniperda*) is about a quarter of an inch long, fleshy, wrinkled across, and legless, largest in the rings behind the head (see figure 2, p. 60); the general colour white, but ochrey near the head, and also somewhat ochrey in tint towards the tail; head dull yellowish.

The Pine Beetle is about the fifth of an inch in length; pitchy or

black; wing-cases rather lighter in colour, somewhat rough, with rows of fine punctures, alternating with rows of little bristle-bearing tubercles (these absent on the apical portion of the second interstice). Fore body somewhat smaller in front, and (as well as the head) punctured; antennæ clubbed at the end, and, as well as the feet (tarsi), rusty red, or brown, or yellow brown (see figure 1, p. 60).

In the early stages of the infestation to the tree or bough, before the tunnellings of the successive attacks have become confused together, the mother gallery and the side maggot galleries are quite clearly distinguishable, as shown in figure, p. 61. Later on, where many perforations like shot-holes are noticeable outside the Pine bark, showing for the most part the exit holes of the beetles which have been developed within, it is probable that the bark can easily be split from the wood, consequently on the quantity of workings between the two, and the galleries will be found interlacing and crossing, as shown in the figure on p. 62, which I copy, with acknowledgment, from a portion of the illustration given by Herr Eichhoff in his valuable work on European Bark Beetles.*

Figure 4, p. 60, shows the appearance of a beetle-infested shoot cut open lengthways to show the tunnelling within. Sometimes these burrows are only an inch in length, and only one in a shoot; sometimes there may be several tunnels, each made by a separate beetle, with a short length of uninjured wood (as figured) between each, occupying altogether, as in one of the worst attacked shoots that I have seen, as much as six and a half inches. This attack affects the shoots of the current year (occasionally the beginning of the boring is made just below the beginning of the *then* present year's growth), and besides the general damage done there is very special injury and loss of value if the central shoot of the young tree is tunnelled, and its growth becomes bushy-headed.

Where much attack has been going on, the yellow or dying shoots on the trees and the numbers of fallen shoots beneath, with more or less beetle presence in them, will attract attention. But, excepting so far as the beetles may shelter in or about them for the winter and renew attack at egg-laying time in the following spring, the mischief here is completed. Gathering up the fallen shoots and destroying them will save some risk of further infestation if the beetles are still in them; but where the battle really has to be fought to prevent serious recurrence of attack is in the infested trees and branches, where the nursery-ground of the maggots and beetles is to be found in or just beneath the bark.

The following account, sent me on September 23rd by Mr. John Clark (forester), from Kelly, Haddo House, near Aberdeen, N.B., it

* 'Die Europäischen Borkenkäfer,' von W. Eichhoff. Berlin.

will be seen exceeds in amount of damage calculated to have been done by excessive gales of wind even that reported to me by Mr. Lambert, from the Hewell Estate Office, Redditch, Worcestershire, in 1896, of which he mentioned:—"One half of this plantation, containing several thousand trees, was blown down by the great gale of March 25th, 1895. It took us many months to cut out the trees, which were all piled one on another."—(L. F. L.) In both cases, as was to be expected, destructive attack of Pine Beetle followed.

On September 23rd (1897) Mr. Clark wrote as follows:—

"On this estate the Fir woods have been suffering very much during the past three years from the attacks of *Hylurgus piniperda* consequent on the gales of 1893 and 1894. Those gales threw down about one hundred thousand trees, most of which in the course of one year after were in the very best condition for Pine Beetle nurseries, and the quantity bred during the past three years has been enormous, which you will understand when I tell you that they have entirely destroyed hundreds of acres of old and young woods. Over one thousand acres of Fir woods have not within them a single tree that has not been attacked by Pine Beetle. I am now preparing to make a great effort to reduce this pest during the coming season. . . . I have made a careful study of the beetle, and watched its course of operations during the last two years, and I am convinced that the most successful plan of beetle destruction is to prepare nurseries for breeding, and destroy them in the nursery."

Mr. Clark's view as to "trapping" by placing wood in a condition for infestation to attract egg-laying, and then destroying the infested wood before the beetles' time of escape has arrived, is one that has been strongly advocated; but we have not yet had report of such broad-scale attacks as to furnish a sufficient amount of growing timber brought, as Mr. Clark proposes, artificially into ill-health to have information as to this especial form of experiment, and it will be of great interest in the welfare of Pine preservation to watch its results. Mr. Clark's plan is as follows:—

"I propose to remove six inches of bark at the surface of the ground from those trees which I intend to be nursery trees, and this will bring the trees thus treated into condition for the beetle as nursery ground. I have satisfied myself that neither a healthy tree nor a dry tree is of any use to the Pine Beetle, but the sick or languishing tree is exactly the conditions it requires for nurseries." [This quite agrees with the adopted views.—E. A. O.] "Where I have not trees to spare as trap trees, I will get trap trees from other woods. I propose to begin preparing trap trees in the beginning of February, 1898, as I will require to put down fresh trap trees once a month for four months. I have found that some trees are good as

nurseries for the whole summer, but it will be necessary to take down the trap trees before the young beetle begins to escape. I found young beetles fully developed by the beginning of June, so that my first set traps will require to be taken down, stripped of the bark, and burned by the first of June, and the beetles that escaped, or that have not begun to breed, will find the traps prepared in March in condition for them, and they seem to have no difficulty in finding out the trees that are in condition for them."—(J. C.)

The following notes from Mr. Clark's report give some of his personal observations as to winter habitat of the beetles which have been boring the Pine shoots, and it will be noticed that he doubts whether hybernation of beetles does (as has been sometimes stated) take place "amongst fog" or "forest rubbish." Possibly this may depend on local conditions. I have never had the opportunity of investigating the point myself, and Mr. Clark being evidently a very careful observer, I give his observations on this point, and also on the holes giving exit or access to the mother beetle's tunnel, *verbatim*, precisely as he favoured me with them :—

"I think the beetle can only live in winter when it is comfortably housed in the annual shoots of the Fir tree. I have never seen them 'amongst fog' or 'forest rubbish,' and as far as I have been able to follow them, they live only in the annual shoots or the twigs of one year's growth from September till April. In the beginning of April many of the beetles leave their winter home, and make fresh attacks upon other twigs. About the middle of the month they appear in pairs on the nursery tree, when they make their way under the bark together, and cut out the hatching tunnel from three to five inches long. The tunnel is usually slightly curved at both ends. Between the entrance hole and the escape hole they usually make two other holes, and sometimes only one; at other times three or four. These holes are made from the tunnel outwards to about one-sixteenth of an inch of the outer surface of the bark, making an opening out less than half the diameter of the hole, and this little opening has threads of bark left over the mouth of it. The purpose of the hole seems to be to admit air and keep out all enemies during the time the eggs are hatching. The entrance hole is closed, and so also is the exit hole. I have not been able to follow the old pair after they leave their first nest. I have found from fifty to one hundred and fifty grubs making their way from the sides of the breeding-tunnel. The perfection of the tunnel can only be seen before other pests find their way into it.

"There are a great host of followers, whose names I do not know, who feed on the deposit, the decaying matter, and often on the pupa. I compute that one average-sized nursery tree in the best condition produces about twenty thousand young beetles.

"Where the bark is more than one-quarter of an inch in thickness, I find that the transformation bed is always on the surface of the wood and immediately under the bark, and in the process of change from pupa to beetle the little body sinks about one-sixteenth of an inch into the solid wood. If the bark is over one-quarter of an inch in thickness I find that the grub makes its transformation bed about one-eighth of an inch from the outside of the bark, where it is safe from all enemies, and the young beetle has little trouble in cutting its way out. . . .

"I have found the squirrels doing good service by eating the grub of the *H. piniperda*. Hundreds of trees have been stripped of their bark since the month of June, but they can only find them where the bark is thin. When they are found under the bark, it is a pity that they cannot find them in the bark; as it is, I believe they have destroyed nearly one-half of the beetles that have been bred during the past summer. From twelve to fifteen feet of the lower part of the stem they do not touch. The squirrels thus mark the trees that are ready to be removed, and the bark burned."

Mr. Clark's observations were accompanied by plentiful specimens, including both attacked shoots and infested bark.

The following notes, with which I was kindly favoured by Mrs. Fleming Hamilton, of Craighlaw, Kirkcowan, Wigtonshire, N.B., refer, like the preceding observations, to injurious attack of Pine Beetle following on injury from the Pine woods having been blown down, but are of special interest as showing yet another branch of the subject. In this case it is the *young* Firs planted to take the place of those destroyed by the gales of wind which are being attacked. On October 15th Mrs. Fleming Hamilton wrote me as follows:—

"I am very anxious to ask your advice about some young Fir trees which are being destroyed by a beetle. Some ten years ago all our woods were blown down by the very severe gale. We have planted again lately, and the Firs seemed to be going on all right till a short time ago, when we noticed the tops of many dying, as well as other branches. This was principally in Scotch Fir. . . .* On cutting off the affected parts, we found beetles had bored their way in and out at the top, thus thoroughly destroying the tree. Can nothing be done to destroy these pests? either painting with any solution or any other ways, as it seems likely to attack all the young trees in the plantations, a very great loss to us, just as they were beginning to get on."

On October 25th Mrs. Fleming Hamilton favoured me with specimens of the good stout Pine shoots which were being injured, together

* Caterpillar attack was also present, presumably of Pine-bud or Pine-shoot Tortrix Moth, but this we did not enter on.

with some of the Pine Beetles, *Hylurgus piniperda*, and a few more observations:—

"The forester tells me he finds them most in the young, and generally in the top, shoot. There are maggot-workings and maggots in the fallen trees, and he has found them under the bark of standing trees, but very rarely. The forester thinks the beetle mostly works its way straight up, not into side and little branches."

The above-mentioned attack formed a most complete example of the permanent character of the infestation when once established, and likewise of the great injury to the value of the young trees by the destruction of the leading shoot.

The reports of the past season and of the previous year, when taken together, give a truly broadscale example of the great loss which is frequently going on when not made the subject of careful investigation (as it was in the above instances).

Prevention and Remedies.—Clearing away infested shoots from the trees where they can be reached, and from beneath them, where the shoots have fallen, gets rid of some amount of the beetles, but not of so many as might be expected, for the beetles (as may be seen by splitting an infested shoot open) are lively and active, and very well able to remove themselves on being disturbed; they are apt at a touch to the branch to "back out of their tunnels and fall to the ground." Therefore in the case of cutting shoots off infested trees, if they are simply cut into a basket, most likely most of the beetles will escape; but they should be put in some kind of bag, out of which the beetles are not likely to make their way, and the contents should be emptied out and burnt as soon as the bag is full. How far it would be worth while on a large scale of work to remove the fallen shoots would be best judged of by opening a few dozens in different places, and seeing whether the beetles are still within; but though opinions differ as to the beetles hybernating in "fog" or "forest rubbish," still a general clearance and burning of all this, together with the fallen shoots, would certainly remove a very likely shelter of infestation.

But *the great point of prevention* is to remove, as soon as possible, all fallen trees or boughs in which the beetles can establish their nursery-grounds (as previously mentioned) between the wood and bark. And not only this, but all slabs of Pine, or pieces of wood with the bark on, which are trimmed off where young Fir plantations are thinned, should by no means be left in the plantations, but should be gathered together and burnt. If there is no bark on the wood the rubbish is harmless as a breeding-ground. "When Fir thinnings are carted from the plantations, it is a very common practice to dress the

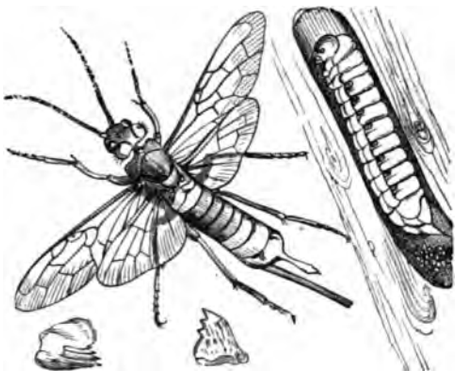
bark off to lighten the carriage in transit to market. The dressing-off of the bark should not be permitted within the plantation; in a year after, the ground round these heaps of bark may be seen covered with brown shoots blown from the growing trees, bored by the beetles which the heaps have nurtured."*

Where attention can be given to *trapping*, some of the slabs and trimmings may be utilized for this purpose. The pieces of waste wood with the bark on may be laid, if of some size, bark uppermost, on the ground, or supported against a tree, and before the time for development of the beetles arrives, they can easily be collected and burnt. But it should be well seen to that operatives who may beg the waste material for firewood do not simply stack it and keep it to suit their own convenience for burning, in which case all the trouble of preparing the "traps" will have been of no use. The beetles will come out and fly to the trees just as readily as from the rubbish in the plantations. A convenient form of trap-wood is made by cutting off lengths of the tops of young Scotch Firs, and setting these against standing trees, or placed in some way in which the "poles" (so to call them, for it is best to clear off the side branches) will not lie flat amongst damp grass, as the beetles prefer a more exposed position for egg-laying. These poles, of course, like all other "trap-wood," should be destroyed before the time of beetle development.

It is hardly possible to enter on all details of minutiæ of preventive treatment, but the great principle is to remove all fallen timber, or broken wood, or sickly trees before they are furnishing infestations of beetles to the trees around; or if the numbers are too great to be dealt with in this way, to do what can be done by barking.

* Note by Mr. W. McCorquodale in 'Manual of Injurious Insects,' by Editor, p. 245.

Giant Sirex; Yellow Fir Wood Wasp. *Sirex gigas*, L.
Common Steel-blue Sirex. *Sirex juvencus*, L.



SIREX GIGAS.—Female "Wood Wasp" and maggot. Jaw of maggot, with four sharp, narrow teeth; and jaw of fly, with three broader teeth—both magnified.

The damage caused by the great grubs of the large four-winged *Sirex* flies to living Fir timber of various kinds is probably much more commonly present than is generally known, for though in the past twenty years I have only in three (namely, in 1878, 1889, and 1890) had important enquiries sent regarding cause of the damage, yet specimens of these "Wood Wasps," and especially of the large black and yellow-banded kind figured above, and known as the "Giant" Sirex, are frequently sent me with a request for the name.

The dark blue Sirex, scientifically *Sirex juvencus*, is known as the "Common" Sirex, but, excepting in the year 1890, I have very rarely had observations of this species, and in the year named, curiously enough, all the observations sent of harm done were from workings of this species. The greatest damage reported was to about forty Silver Firs on a property near Whitehaven, Cumberland, of which three-fourths were said to be practically dead, "the residue in a moribund state." The trees were over seventy years of age, and the damage was estimated at a little over 1200 cubic feet of timber irretrievably ruined. In a block of damaged wood measuring fourteen inches in length by eight in diameter, thirty-three perforations were counted from which perfect insects had made their escape.

In regard to the *Sirex gigas* (figured above), in 1878 several trees some miles apart near Dalkeith, N.B., were found to be badly infested by it; one of these (a fallen Spruce Fir) was found to be "swarming" full of it. But the worst infestation I have seen myself came under my notice at Sedbury Park in West Gloucestershire. I noticed specimens on the wing there during many years whilst still resident there

during the life-time of my late father), and occasionally saw recently felled trunks from the Fir plantations thoroughly infested with Sirex, of the species *gigas* and also *juvencus*. On one occasion I saw as many as twelve to twenty specimens of *gigas* captured in a few hours as they came out of a Larch trunk lying in the home farm wood-yard, and numbers of very large ichneumon flies piercing so firmly into the infested log with their ovipositors, that they were not always able to withdraw them. Of these I cannot speak certainly as to species, for in those days I had not the requisite works or assistance for identification.

In 1890 I had observations of the *S. gigas* being observed as doing much harm in Lord Meath's woods at Kilruddery, Bray; likewise from timber at Wells, Gorey, Wexford; and specimens were also sent from near Hacketstown, Carlow, all localities on the east coast of Ireland, and so far as I am aware the presence of the insect had not been recorded as observed in Ireland previously.

In the past season I was favoured by the following note of great prevalence of grubs of the "Giant Sirex" in Larch by Mr. Wm. Forbes, of Swinton, Masham, Yorkshire. Mr. Forbes observed:—

"I am sending specimen of . . . also the larva of the Giant Sirex. This last-named insect is doing an enormous amount of damage in the Larch plantations under my charge. I am going to cut down every infested tree I find, and insist upon having the fencing tarred, and the ends of the galleries stopped up with Burgundy pitch. There is not a creosoting plant on the estate, if there had been, I should have tried creosoting the rails and posts. Every slab must be burned to destroy eggs or larvæ."—(W. F.)*

An interesting point regarding the (possibly) dangerous destructiveness of the tunnelling of Sirex grubs in timber, which has not, I believe, been often brought forward, is their occasional presence underground in coal-mines; and regarding this, on May 26th, Mr. Malcolm Burr, F.E.S., writing from Dormans Park, East Grinstead, favoured me with the following observation:—

"I enclose you a *Sirex gigas* that may interest you, received from Mr. Nath. M. Griffith, of Ruabon, a mining engineer, who tells me they find them underground in the collieries in that district. They are said to burrow holes in the timber used for prop-wood, and are supposed to come with the timber from Norway. I have taken the species near Oxford."

* In reply to Mr. Forbes's request for identification of the grub sent, I mentioned that it was certainly that of a Sirex; but the larvæ of the *gigas* and of the *juvencus* are so very similar in appearance, that, as the grub was not living but preserved in spirit, I could not pronounce with certainty as to species. For practical purposes, however, this was unnecessary, the habits of the two kinds being so very similar.

Of the Sirex, without distinction of species, found in this country, Mr. P. Cameron* mentions that he considers the vast majority of the specimens taken alive have been introduced with foreign timber. They are often found near wood-yards, railway stations, and *in coal-pits*. (The italics are my own.—E. A. O.)

The following note, with which I was favoured in reply to my enquiries, by Mr. John Gerrard (inspector of mines), on October 1st, from Worsley, near Manchester, bears on the matter with regard to the chief part of the infestation being considered to be imported, very similarly to the above observations:—

"Hardly a year passes without a specimen" [of Giant Sirex—E. A. O.] "coming under my notice, mostly females. Have never seen the grub, nor heard of any gallery being seen in the props. All are in or near mining timber; the timber imported from Norway."—(J. G.)

From its great size and brightly contrasting colour of its yellow and black markings the Giant Sirex is a very conspicuous insect. The female is from an inch and a third to over two inches in the spread of the wings; head black, with some yellow markings; and the body between the wings and the abdomen, excepting the first two and the last three rings (which are mostly yellow), black also. The abdomen (see figure, p. 69) ends in a long point, beneath which is, in its horny sheath, the strong ovipositor with which the insect bores through the Fir bark to deposit its eggs. The male is smaller, with the abdomen yellowish, excepting the first and last segments, which are black.

SIREX JUVENCUS.—Common Steel-blue Sirex and maggot.

The *Sirex juvencus* is a most variable insect, both in its size and colouring. The female is commonly blue-black, with brownish or

* See 'Monograph of British Phytophagous Hymenoptera,' by P. Cameron Ray Society, vol. iii. p. 134.

rusty-colour in the legs; male blue-black, abdomen with margin of the third and the whole of the four following segments red; the hinder shanks and feet dilated and compressed. The size varies from about half an inch to an inch and a third, or an inch and a half in length, and from about three-quarters of an inch to a little above two inches in the spread of the wings; and in the case of specimens sent me, the variation in size appeared to coincide with whether the conditions of the maggots during their feeding-time had been favourable or otherwise. Amongst specimens from some buried wood I had a male just under half an inch long, and a female five-eighths of an inch long, including the ovipositor.

Sirex maggots are soft and fleshy, whitish, and cylindrical, with smooth shining heads, furnished with strong square jaws, somewhat differing from each other. The three pairs of legs are short, and without marked divisions into joints; the prolegs beneath the abdomen are absent; and at the apex the abdomen is acute, ending in a sharp horny spine. The pupa resembles the perfect insect, lying soft and white, with the limbs laid along the breast and body.

The female Sirex lays her eggs in various kinds of Fir, as Scotch Fir, Silver Fir, Spruce, and Larch, and is considered to choose for this purpose trees which are past their prime, or from some cause or other are wholly or locally in not full health. It has been stated that even if a small portion is injured the Sirex will choose this spot for egg-laying, and from this centre the grubs will spread in the wood. They are also stated to lay eggs in fallen trees, or in felled trunks left lying in the woods.

The maggots bore large galleries in the solid timber, sometimes in sufficient number to riddle the trunks, and are full-grown in seven weeks, and the further change to the chrysalis takes place in the wood, but the date is considered to be uncertain,—it may take place immediately after full growth of the larva, or be delayed for an uncertain period. Consequently the imago (the perfect Sirex flies) may appear after delayed development from the most unexpected places, as from furniture or manufactured timber.

Prevention and Remedies.—Where attack is found to be prevalent in growing timber, the best treatment is to fell all that is found to be infested, and have it taken at once to the saw-pit and cut up and disposed of according to condition. Some parts would probably be free from attack, and might be used for any rough work, and other parts which were infested, and still had the insects in some stage alive within, should be burnt, or at least so treated that there was no danger of the infestation getting abroad. Felled trunks which are found to be infested should be similarly attended to, and also it should be borne

in mind that blown-down or recently felled trees are localities selected for egg-laying where Sirex are prevalent.

The attack is not often reported as injurious to a serious extent to growing timber, still the area of mischief has increased of late years, and as the insects, which make themselves perfectly at home in this country, are found to be very notably present in the vicinity of imported timber, the subject of prevention of spread to neighbouring Fir plantations may be worth attention.

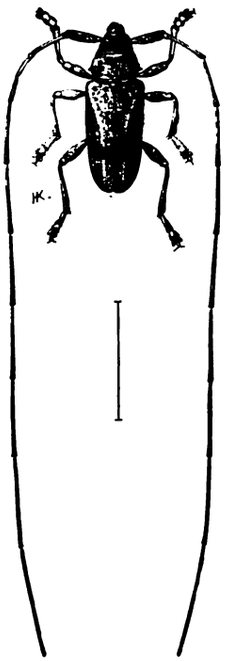
Timberman Beetle. *Astynomus ædilis*, L.; *Acanthocinus ædilis*, S.

This beetle, which is remarkable for the extraordinary length of the antennæ of the male, is found in great numbers on the Continent, but appears to be rarely met with in this country, excepting at Loch Rannoch, Perthshire, N.B., where it is recorded as being seen not uncommonly.

The only specimen I have had which could be supposed to be of truly British growth was the one from which my figure was taken, and was sent me alive from Kinnaird, Strathpeffer, Ross-shire, on August 12th, 1895.

The maggot lives under bark of Pine and Fir, and often "perforates the wood of the fallen stems," and makes large galleries in Pine stumps, forming "a nest with coarse gnawed fragments near the surface, in which it changes to pupa."

It does not appear to do mischief in this country, but, like the insects mentioned in the preceding paper, its occasional appearance in coal-mines (to the very natural perplexity of the finders) may make just the following observation sent me, with a specimen accompanying, of interest.



ASTYNOMUS ÆDILIS, slightly larger than life; line showing natural length.

On September 2nd Mr. W. Wilson, head-master of Bothal N. School, Ashington, Morpeth (Northumberland), wrote me that he would be glad of the name of a specimen enclosed, as he had not seen one before in the district. "It was caught in the coal-mine, two and a half miles from the bottom of the shaft." As the insect is of such rare occurrence here, I suggested that in all probability it had been imported in timber used for workings in the mine, which proved to be

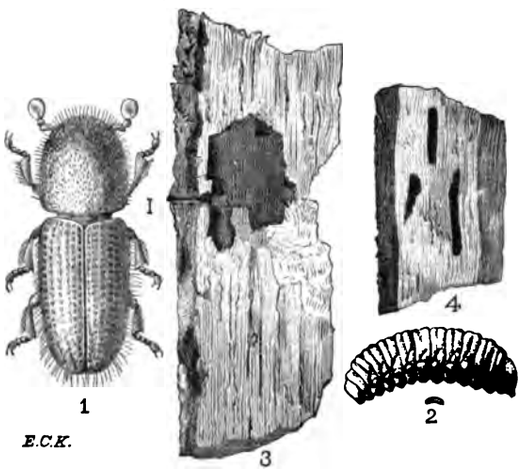
the case. Mr. Wilson wrote, on September 7th:—"Your suggestion that the beetle came from the north of Europe is quite correct, as the wood (Fir) used in the mine is brought from Norway."

As it is very unlikely that either this kind of beetle or the Sirex flies, previously mentioned, could lay eggs and set infestation on foot in timber in the condition used in mines, their presence scarcely seems of practical importance, for the number of exit-holes would be a pretty safe guide as to where so much damage had been going on as to render the wood insecure for props or mine service, but the subject is at least one of some curiosity.

The Timberman Beetle is a very pretty creature; the general colour of a brownish ash or smutty violet, and the wing-cases marked with little black spots, and with two somewhat oblique brownish bands, the front one (in the specimen figured) hardly extending beyond the edge of the wing-case, and the expanse of the antennæ as the beetle moved gently along bearing them at right angles to its body was, as near as might be, six inches.

PLUM.

Shot-borer Beetles—*Xyleborus saxeseni*, Ratz. = *Xyleborus xylographus*, Say; also *Xyleborus dispar*, Fab.



XYLEBORUS SAXESENI.—1, beetle; 2, larva—magnified, with natural length of each; 3 and 4, cell, natural size, showing broad and flat, and also narrow view.

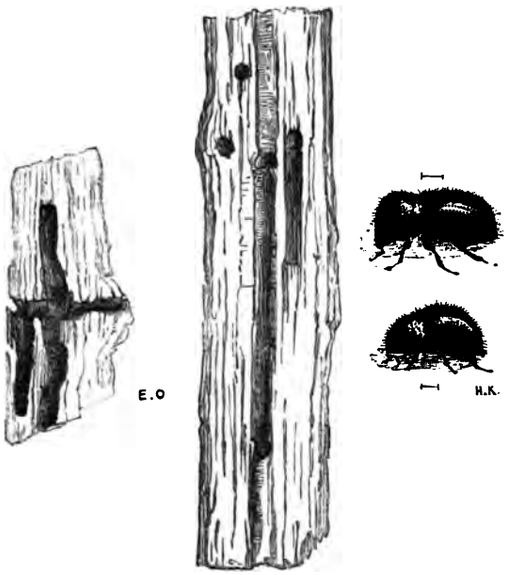
The following observations refer mainly to the much-to-be-regretted appearance of yet another kind of "Shot-borer" Beetle, namely, the *Xyleborus saxeseni*, as an infestation in wood of Plum trees. Up to the observation of its attacks in the early part of the past season, although the presence of this species in England was known of by entomologists, yet, so far as I am aware, there was no record of it having occurred here as a decided orchard pest, and naturally when the injuries were noticed they were attributed to the attacks of the *Xyleborus dispar*, which had caused much mischief at Toddington (Gloucestershire) and elsewhere a few years ago.

Excepting to skilled examination, there is much similarity in the two attacks. I know of no difference in the appearance of the shot-hole-like perforations in the bark accompanying each. The beetles themselves require knowledge and a magnifier for differentiation, and the great and striking difference of the flat cells of the *saxeseni* from the borings of the *dispar* are not noticeable without internal investigation of the attacked wood. Therefore, before entering on observations of the new pest, the *saxeseni*, I have given the few following notes of the main characteristics, together with a figure of *X. dispar* for the sake of comparison (see p. 76).

It will be only too well remembered by various leading orchard fruit-growers in the West of England that in 1889 a very small dark-brown beetle, which until that time had been considered one of our rarest species, appeared in such numbers as an infestation to Plum trees, as to cause serious mischief. From the bark of the attacked trees having the appearance of being perforated by shot-holes, the beetle is very commonly known as the "Shot-borer." Scientifically, it is the *Xyleborus dispar*, from the *disparity* in size and shape between the male and female beetles. The female is about the eighth of an inch long, narrow, and cylindrical, with the fore body (*thorax*) raised in the middle; the male is very minute, only about two-thirds of the length of the female, and broader in proportion, the thorax flatter than in the female (without the "hump").

The injury is caused by the beetles boring their tunnels through the bark of the branches or young stems of Plum trees (or other trees, as the case may be, but in this country the young Plum trees are what suffer the most), and then sometimes running their galleries so as partially to ring them, or, after boring to the central pith, to clear out an inch or more of this (see figure, p. 76), or, again, to make upright tunnels in the hard wood, or sometimes run their tunnels so as quite to girdle the branches. From the nature of the injury, the flow of the sap is checked, and the tree is often killed with a rapidity which is unaccountable, until investigation shows what has been going on in the wood.

The beetles breed in the tunnels, and in September (in this country) borings may be found so crowded with female beetles that there appears to be hardly room for one more. The males are more rarely met with; but whilst amongst fifty to sixty female "Shot-borer" Beetles which I took in September, 1889, from their borings, I only



XYLEBORUS DISPAR.—Female beetle (uppermost), male (lowest), magnified, lines showing natural length; horizontal and vertical workings in Plum stems.

found one male beetle,—in the following December I found more present, and on or about the following 10th of January I found in a piece of Plum stem of two inches and a quarter in diameter about seventeen males to six females.

Very complete observations of the infestation were sent by Mr. C. D. Wise from the Toddington Fruit-grounds in 1889, and were duly reported (see my 'Thirteenth Annual Report'), and the prompt remedial measures taken, especially that of cutting down and burning such trees as were attacked, acted so well that in the following year Mr. Wise reported that only one case of attack had been found, and since then until the present year (1897) no further reports of presence of Shot-borer Beetles have been sent to an extent calling for mention, if indeed anything at all of their presence has been noticed.

This year, however, on June 9th, Mr. C. D. Wise wrote me, from the Toddington Fruit-grounds, that they had a very severe attack of Shot-borer Beetles. He mentioned:—

"In one plantation of about eight acres, containing about one

thousand six hundred trees, we have already cut down one hundred, killed by the borer. In another field, about the same size, quite as many trees have been destroyed. We burn the trees directly we find a trace of the attack, but this does not seem to keep the enemy under, and it is difficult to know what to do."

The infestation was considered (just generally speaking) to be *X. dispar;* but, wishing to have some special examination, I begged Mr. Wise to be kind enough to let me have some specimens, to which he replied on June 19th, mentioning that he was sorry to say that he could send me (practically) any quantity of infested stems of Plum trees showing Shot-borer Beetle attack, and that he then sent me the stem of a tree, and also a portion of the branch, and that he found as many in the branches as he did in the stem.

To what extent *dispar* might be present in the trees, of course we cannot tell, but the specimens, which Mr. Wise furnished me with a most liberal supply of, showed that, though some small amount of the characteristic workings of *dispar* were to be found, the chief amount of workings were those of *Xyleborus saxeseni*, Ratz., then very fully occupied by attack chiefly in larval condition. Of these I took the following observations.

On July 22nd, on splitting part of one of the above-mentioned pieces of Plum stem (of two and three-quarter inches in diameter) longitudinally, I found a horizontal tunnel running from the outside of about a quarter of an inch in length, on each side of which, beginning at the above distance (one-quarter inch) from the outside of the tree, a flat vertical cell was hollowed out, three-quarters of an inch long at the greatest height, and five-eighths in width. The shape of this flat chamber was somewhat squarish (see figure 3, p. 74), about two-thirds of it being above, and one-third below the mother gallery, of which some traces still remained, and which crossed the flat cell, and then was continued merely as a tunnel (a distinct gallery) for about three-eighths of an inch further, where it stopped, the extremity being filled with about half-a-dozen very young larvæ and a few eggs.

The surface of the flat chamber (as seen in the side remaining after the other side had been cut away in the course of examination) was covered for the most part with a very thin coating of wax-like material, greyish in colour, and with a somewhat sweet scent, and the surface of the wood of the chamber, wherever it was visible, was certainly not of the black colour so noticeable in connection with the workings of the *Xyleborus dispar*. It was rather of a brown colour, and moist-looking appearance.

This flat cell, or gnawed-out chamber, had only space enough between its two upright sides (see figure 4, p. 74) to accommodate the larvæ, which were for the most part apparently full-grown, and in

many cases not pure white, but tinged with colour, and with the yellow contents of a portion of the length of the food-canal showing distinctly—this circumstance and some amount of wet "frass" which was present pointing to their having been feeding on the wood; and the circumstance of there being this flat chamber gnawed out of the solid wood, on either side of the mother gallery, and containing at an estimate, several (two or three) dozen grubs, does not appear possibly to be accounted for in any other way than by it being hollowed out by the gnawings of the larvæ. Amongst these larvæ I found one advanced to the pupal stage,—milk white, with the wing-cases folded beneath it.

On July 28th, on examining the split pieces of Plum stem from Toddington, I found upon one which lay with the bark side uppermost that there were two heaps of wood-dust, one about half an inch by three-quarters broad, the other about five-eighths of an inch each way. This thrown-out wood-dust showed that there was damage going on from workings inside, and on splitting the piece of wood open, I found two parties of maggots within about two inches of each other.

These were of different ages, whitish, and legless, and distinctly lobed, the head very shining white, or, in the older specimens, with a faint yellowish tint. Whilst still alive or quite fresh the three first segments appeared to me to be somewhat inflated below, and but slightly corrugated above; the others slightly lobed below, and much corrugated longitudinally above.

In this instance the cell was a flat cavity just inside the outer wood, this chamber being about three-quarters by one-quarter of an inch in dimensions of width, and in thickness only about sufficient to accommodate the full-grown larvæ or beetles; and, as in the instance previously described, it was patched over the surface with the white fungoid formation known by writers as "ambrosia," this being sprinkled with workings of wood-dust, or "frass" of wood.

In the case of the galleries and chambers of *Xyleborus dispar*, the wood has a blackened tint, almost as if it had been burnt with a hot wire, where the fungus was removed; but in those of *saxeseni* the chambers were much lighter in tint, and it is also noted by Dr. Bernard Altum * that in his own observations he found the brood chambers of the *saxeseni* and *dryographus* un-dyed.

The smallest size of larva that I measured in the numerous collection was just over the thirty-second of an inch in length; and I found upwards of fourteen larvæ packed together in the inner part of the slit-like cavity, and perhaps a dozen or more besides. From the extreme narrowness of the chamber it was difficult to dissect out the specimens so as to be sure of amount of contents.

* 'Forst Zoologie,' III. Insecten, p. 277.

I found amongst the above larvæ three pupæ; these were readily observable, even with moderately magnifying glasses, by their bright shiny whiteness; the hinder edge of the thorax was well defined, and so was the longitudinal striation of the wing-cases.

Notices of much injury from "Shot-borer" to Plum were also sent from near Evesham. A proprietor at Longdon Hill, in that neighbourhood, mentioned that his plantation of six years' growth, and ten or eleven acres in extent, and very promising, had been badly affected, and quite ten per cent. of the trees had succumbed.

In other places in the neighbourhood losses also were sustained, and a wish was expressed for certain information as to the cause of the mischief; but so far as I saw from specimens sent me, although there appeared to be a small quantity of the *Xyleborus dispar* (which did such great harm a few years ago) present, the greater part of the damage then in progress was caused by the *X. saxeseni*.

As this species, although not new in England, is only recently observed (as above) with us as seriously destructive to Plum wood, I took the opportunity of consulting Dr. James Fletcher, the Entomologist of the Experimental Farms of the Department of Agriculture, Ottawa, Ontario, Canada, during his stay in England, on the subject, and he carried a sample with him on his return home, regarding which he was good enough to write, on October 5th, as follows:—

"I have delayed writing to you until I heard from our authority on *Scolytidæ*, Prof. Hopkins, of Morgantown, West Virginia. He says this is a very interesting species, and has quite a history. It seems that Say named it *X. xylographus* in 1825, and a short time after Ratzburg named the same thing *X. saxeseni*, and although this fact has been referred to in publications by Eichhoff, Schwarz, and Packard, our European brethren persist in calling it *saxeseni*. It is an exceedingly common species here in West Virginia, occurring in the wood of old Apple trees. I have compared your English specimens with my large series of specimens collected here, and those from France and Germany, and it appears they must all belong to the same species."—(J. F.)

The above communication is, I think, of much interest as identifying our infestation by comparison of specimens as similar to that of the United States of America and Europe, and also as giving the reason for the continuance of the difference in specific name by the American and European entomologists.

The following extracts, taken from the notes published during the present year by Mr. H. G. Hubbard, one of the "investigators" of the United States Board of Agriculture,* agree excellently with what was

* See "Ambrosia Beetles of the United States," by H. G. Hubbard, in 'Some Miscellaneous Results of Work of the Division of Entomology,' United States Department of Agriculture, Washington, 1897, p. 24.

observable in the specimens sent me from Toddington of the *Xyleborus xylographus*, Say = *saxeseni*, Ratz. :—

"The young in this species are assembled in a brood chamber. . . . It is constructed at the end of a gallery which penetrates deeply into the heart, or remains in the sapwood, according to the amount of moisture in the tree-trunk, . . . and stands vertically on edge parallel with the grain of the wood. The space between the walls is not much greater than the thickness of the bodies of the adult beetles." [See my own observations preceding on the narrowness of the chamber from side to side, and also as to the larvæ working away the wood, p. 78.—E. A. O.] "The larvæ aid in extending the brood chamber. They swallow the wood which they remove with their jaws, and in passing through their bodies it becomes stained a mustard yellow colour. Great quantities of this excrement are ejected from the openings of the colony, but a portion is retained, and plastered upon the walls, where it serves as a bed upon which there springs up a new crop of the food fungus."

The nature of this fungus is of great interest, and has been the subject of much discussion from the time of Canon Schmidberger, who described this substance (of which the nature was not then known) under the fanciful name of ambrosia,* up to the elaborate observations given, with illustrations accompanying, by Mr. H. G. Hubbard in his paper on the "Ambrosia Beetles," lately published, and referred to in note at preceding page.

At p. 9 Mr. Hubbard states that "the term Ambrosia Beetles is used as a convenient one to distinguish from the true bark-borers and bark-eaters" [the Elm-bark Beetle, *Scolytus destructor*, for example,—E. A. O.] "the timber-boring *Scolytidæ*, which push their galleries deeply into the wood, and which feed upon a substance called ambrosia. . . . Their food consists not of wood, but of certain minute and juicy fungi propagated on the walls of their galleries." These fungi, it is stated, are of different kinds, each species of "Ambrosia Beetles" (or, if not strictly each species, only those most closely allied) feeding on one kind, and one only of ambrosia fungus. Some of these fungi are like a pile of beads in appearance, but the *Xyleborus saxeseni* (= *xylographus*) fungus is of upright stems set close together, with a swollen cell at the end of each, and not unlike in general appearance, when enormously magnified, to a great number of short, very thick-stemmed pins, with round heads, set very closely together.†

Regarding the habits of *X. xylographus*, Mr. Hubbard mentions that it breeds only in dying trees, and generally only in trunks of large

* 'Naturgeschichte der Schadlichen Insecten,' von Vincent Kollar, Wien, 1837, p. 264; and English translation, called 'Treatise on Insects,' London, 1840, p. 257.

† For figure, see p. 25 of Mr. Hubbard's paper, previously referred to.

size. It appears to be partial to rather hard woods, like Oak, Hickory, Beech, and Maple, and is found wherever these trees grow, both in this country and in Europe. It does much injury to timber, and in cut lumber the broad flat chambers produce defects which cannot be remedied by plugging."

In regard to distribution, it is mentioned by Herr Eichhoff* that "*saxeseni* is not only distributed over the greatest part of Europe, but is also found in the Canary Islands, in North America, and probably also in Japan. Amongst the bark beetles, it is a remarkably general feeder, for it lives and breeds not only in the wood of the most different kinds of leafy trees, as Oak, Beech, Birch, Maple, Lime, Poplar, and orchard trees, but also in various of the needle-leaved trees" [as Pine and Fir].

In regard to dates of appearance, Herr Eichhoff notes that females of the first brood swarmed in his wood stores at the end of May and June. Also that Noerdlinger found in August pupæ already yellow-coloured, which developed a few days after; and Schreiner found on one occasion, on September 12th, only larvæ; on others, at the end of November and beginning of December, there were with the still living mother beetles what were certainly young beetles, besides full-grown and also still quite young larvæ. He (himself) found during winter young beetles, with still half-grown and full-grown larvæ. From this, Herr Eichhoff points out there can be no doubt that the beetles developed in August, and later again fly and breed, and from these proceed the hybernating beetles and larvæ.

The year's circle of propagation is thus completed from the beetles seen in great numbers appearing at the end of May, through a second generation to the hybernating brood supplying the spring or early summer attack.

We have not yet traced the infestation all the year round here, but presumably it is the same. In the chambers of *X. saxeseni* sent me on July 19th, I found eggs, larvæ, and one pupa still milk-white; and a little later on, more pupæ. Early in September I found six or eight beetles in my rearing-box which had come out of the Plum wood, and which proved, on submitting them to Mr. O. E. Janson for certain identification, to be females of *X. saxeseni*, with the exception of one single specimen of the male, which sex appears to be rare in this species as well as with *X. dispar*, as Herr Eichhoff notes, in a summary of numbers counted, a proportion of only fifteen male beetles to three hundred and seventy-four females. The winter condition I had not the opportunity of investigating.

This species is somewhat slender and elongate in shape; the

* 'Die Europäischen Borkenkäfer,' von W. Eichhoff, Kaiserl. Oberforster in Mulhausen, i. Elsass. Berlin, 1881, p. 280.

females pitchy black, with a small amount of grey hairs, and rusty yellow antennæ and legs; the males shorter, and of a paler brownish colour, and with longer hairs. The female is about the eighth of an inch, the male somewhat less in length. They may be readily distinguished from *X. dispar* (the only species which at present there may be occasion to distinguish them from here) by the female of *dispar* having the thorax (or fore body) large in proportion, and raised in the middle into a kind of hump, while the male, which is only two-thirds of the length of the female in this species, is remarkable for being much wider in proportion, and flat on the back. From all other species of *Xyleborus* it is considered that *saxeseni*=*xylographus* may be distinguished "by the very regular rows of small but sharp teeth upon the declivity of the elytra." (See 'Ambrosia Beetles,' referred to previously.)

In the course of correspondence on the "Shot-borer" infestation, I was favoured by Mr. C. D. Wise with an observation of a coincident appearance of Mites (*Acari*) in such vast numbers on the stems of Plum trees infested by the "Shot-borer" that, on working up the subject, there seems to be good ground for hoping that these may be an important help in keeping both species of *Xylebori* in check.

On July 30th Mr. Wise wrote that there were "hundreds, even thousands" [of the creatures which at first were taken for little beetles], "crawling about all over the stems of the trees, and these have spread to the trees adjoining." A few days later Mr. Wise mentioned that they were to be found in hundreds on the trees which were dying from attacks of the "Shot-borer"; and successive letters showed the vast numbers to which the infestation was increasing, as on August 7th "they are all over the stems of the trees in all directions"; and on the 12th, "the stems of our trees are covered with millions of them."

As it was exceedingly desirable to have an authoritative opinion what the hordes of creatures were doing, I suggested to Mr. Wise that we might venture to request Mr. Albert D. Michael (of Cadogan Mansions, Sloane Square, London, S.W.) to assist us by identification, and on August 23rd he was good enough to write as follows:—

"The creatures sent are *Acari*, as Miss Ormerod correctly says; their name is *Oribata lapidaria*. They are very abundant, and probably the fine season has caused them to increase to an unusual degree. I do not think, however, that you need be alarmed at their presence; they are vegetable feeders, but I never heard of their doing any practical harm to the trees or plants which they are found on; they feed chiefly on lichens and minute fungi, and will, I should think, help to keep your trees clean rather than injure them. I observe that the scraps of bark which you sent me are covered with lichens (micro-

scopic), &c., just what these *Acari* like. If it were my case, I should let them alone; but if you wish to destroy them, it will be rather difficult to do so while they are in the adult stage; chemicals are useless then, as they do not penetrate the hard shell; boiling water would do it at once if it could be conveniently applied without injuring the trees, but I believe that there is often a practical difficulty about this. If it cannot be done, a sticky material, such as soap, tar, &c., would catch large numbers, but not all.

"When the creatures are in an immature condition, rather earlier in the year (probably about June), the ordinary paraffin and soap solutions (strong) would probably kill them if applied three or four times at intervals of ten days or a fortnight, so as to catch fresh batches as they hatch from the eggs (which are impervious to chemicals).

"If you wish to know the immature stage by sight, you will find a coloured illustration of it in my 'British *Oribatidæ*,' Ray Society, plate v. figure 2. It is very different from the adult; but, as I have said before, my own impression is that the best thing you can do is to let these creatures alone."—(A. D. M.)

The family of the *Oribatidæ*, which are often known as "Beetle-mites," because, in the adult stage, they have a hard skin (chitinous exo-skeleton) like beetles, are very small somewhat globular *Acari*, often black or brown in colour, and have eight legs. In their first condition (that is, after hatching from the egg) they are soft, and have only six legs. The *O. lapidaria* (of Lucas), mentioned above, is only about a third of a millimètre in length,* and dark brown, and usually, though not quite always, also shining in the adult state; in the preceding condition it is more of a diamond-shaped form, and "orange red varying to dark pink" in colour; in the first stage most of the *Oribatidæ* have little colour. (See Mr. Michael's work, previously quoted.)

The above remarks on this fungus-eating "Mite" are submitted in view of the possibility of it being in some degree a natural protector against increase of the "Shot-borer" or "Ambrosia" Beetles, by robbing them, *for its own support*, of the "ambrosia fungus," on which they mainly feed. We cannot tell how this may be without further observations verified by an expert. Unfortunately I have not sufficient knowledge of these "Mites" in their early stages to make my identification trustworthy; but it may prove of some interest to mention that, about December 11th, on examining my few remaining specimens of *saxeseni*-infested Plum wood, I found a number of minute white "Mites" straying about the "ambrosia" patched surface of one of the *saxeseni* brood-chambers; and on the 14th I found them still there or

* A millimètre is the twenty-fifth part of an inch.

in the entrance gallery, one of them being advanced then to a pink colour, and a shape resembling the figure of the "nymph" state of *O. lapidaria* given in plate v. of Mr. Michael's '*Oribatidæ*,' vol. i., previously referred to.

Prevention and Remedies.—One of the most plainly serviceable of these is cutting down and burning the infested portions of all trees—Plum, Apple, or otherwise—found to be undergoing attack, taking the shot-hole-like perforations in the bark and the wood dust thrown out as a guide, to some degree, for investigation of the nature of the mischief going forward within. Presumably, also, the use of what is called "trap-wood" would answer as well for attracting this species (the *saxeseni*) as the *dispar*. These traps may be arranged by setting poles of any kind of wood that the beetles naturally frequent, with one end in the ground so as to keep them fresh for a while, and examining them every three or four weeks, and destroying them if found to be infested. The season for "trapping" is March to August or September, or later still in the year, if examination shows infestation continuing. Felled trees also may be centres of spread of infestation if not looked to, and also stores or timber-yards near orchards may need attention as to infested wood stacked there.

The mixture known in Canada as the "Saunders' wash," and referred to at p. 47, preceding, could not fail to be of use. This is soft-soap reduced to the consistence of a thick paint by the addition of a strong solution of washing soda in water; "this, if applied to the bark of the tree during during the morning of a warm day, will dry in a few hours, and form a tenacious coating not easily dissolved by rain."

Another method of dealing with attacks of *Xylebori*, or "Shot-borers," is plugging up their entrance-holes, in regard to effect of which it is noted at p. 11 of Mr. Hubbard's paper, previously quoted, that by closing the outlets of the galleries through the bark, or by spraying into them kerosine or some other noxious liquid, the contained beetles are so discomposed that they run in all directions, and by trampling on and crushing the young larvæ and eggs, and breaking down the exceedingly delicate fungoid growth, a state of things is induced in which the living insects are destroyed.

In the same paper, at p. 18, under the head of "Remedies," are the following notes, which I give at length, as the most recent observations on the subject:—

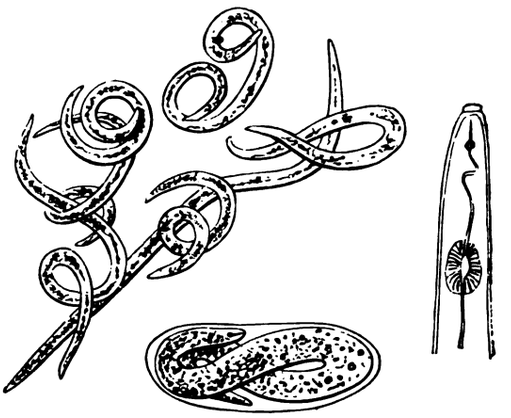
"From what has been said of the nature of the food of these beetles, it is evident that any method by which the entrances to their galleries in the bark can be closed will effectually put an end to the progress of their colonies. Perhaps the best means of accomplishing

this is by coating the trunks with dendroline or raupenleim. A light brushing or spraying of the bark with creosote or kerosine will sometimes accomplish the same result, especially at the beginning of an attack. But this cannot be depended upon to permanently protect the trees.

"Valuable fruit trees which have suffered injury from fire or frost cannot always be protected from attacks of the borers by coating the bark, because of the risk of injury to the buds, which must be allowed to grow upon the trunks. In such cases if borers enter the wood their holes must be plugged. An excellent method is to insert an iron wire as far as it will go, cut it off, and leave the piece in the hole. The inhabitants of colonies thus imprisoned are unable to extend their borings, and inevitably perish."—(H. G. H.)

STEM EELWORMS.

"Tulip-root" in Oats, **"Stem-sickness"** in Clover, caused by **Stem Eelworms,** *Tylenchus devastatrix*, Kuhn.



TYLENCHUS DEVASTATRIX, Stem Eelworms.—Anterior portion of female showing mouth-spear; and embryo in egg; all greatly magnified: anterior portion magnified 440 times. From figures by Dr. J. Ritzema Bos.

During the past season "Tulip-root" appears to have been more than usually prevalent in the Oat crop. Very characteristic specimens of this peculiar malformation, so called from the base of the Eelworm-infested stem being swelled into a bulb-like or "tulip-rooted" form (often with a number of short, swelled, and contorted shoots surrounding

the base of the bulb), were sent me from widely separated localities, from Kent up to Pincaitland, East Lothian, N.B.

This attack, which there has been occasion to refer to frequently since it was first brought forward in 1886,* is caused by presence of Eelworms, so minute that, being only about the twenty-fourth of an inch in length, they are invisible to the naked eye, but with the help of a magnifier they are to be found in swarms in egg, larval, and male and female condition in the deformed parts of the infested plants. In these they form for the most part, as, for instance, in "Tulip-root," Clover "Stem-sickness," and "Onion-sickness," swelled growths, by which the attention of those acquainted with the different forms of development may be at once directed to the mischief that is going forward, and unless the attack has been allowed to become too much advanced it may be mitigated, or, in the case of Clover Stem-sickness, successfully got rid of by various applications (see p. 94).

The deformed growth is an external guide, and internally the attacked plants of Oats or Clover will often be found, where the attack is somewhat advanced, to be more or less hollow, with the surface of the cavity spongy, and gradually, with increase of the disease, the surface becoming yellowish or brownish with decay, and in this I have found great establishment of the Stem Eelworms. The Eelworms are also to be found in the contorted shoots of "Tulip-root" (see figure, p. 88), and I have found them at various ages in very young Oat plants sent to me in November, but amongst these I did not find more than a few that were apparently fully grown, and the "Tulip-root" growth of the Oat plant was not then developed.

For figures of worms and egg, see p. 85.

It may just possibly be of some practical interest (in regard to being on the alert to watch for appearance of first signs of "Tulip-root") to draw attention to the generally late sowing time which was necessitated in the past season by the adverse weather of the early part of 1897. "Not for years had the arrears of tillage work been so great at the middle of April, heavy lands in most districts and light lands in not a few being more or less waterlogged. . . . Teams were kept hard at work, completing in the latter half of April tillages that ought normally to have been finished a month earlier." †

In repression of Eelworm attack, that is, both in destroying the pests and restoring healthy conditions, it has been found that such circumstances as give a sound vigorous growth are very important; therefore it may be found that the circumstances which were unfavourable to the Oat plant in its early stage had to do with the prevalence of Tulip-root. But however this may be, more applications

* See my 'Tenth Annual Report on Injurious Insects,' pp. 35–47.

† See "Agriculture in 1897," 'The Times,' Dec. 27th, 1897, p. 8, column 1.

were made to me than commonly occur as to presence of the disease; and it is rather curious that though the Tulip-root form was very markedly present, I had not any samples sent me of the other form known as "Segging," from the widened form of the leaves with waved edges resembling those of Sedges.

A few other points of interest occurred in connection with some of the samples sent.

The following observation, which was sent me on May 5th, in the course of some communication as to Tulip-root in Oats, by Mr. F. R. Armytage, from Windsor House, Shrewsbury, is of practical interest relatively to the power of these Eelworms of bearing "desiccation," that is, of being thoroughly dried, and remaining in this state for some weeks without any injury beyond loss of power of motion for the time being. After some remarks on specimens of Tulip-rooted Oats previously sent to him, Mr. Armytage observed:—

"It may interest you to know that after placing the worms on a slide with a drop of water, I put the slide away for quite six weeks, at the end of which period, although the water must have evaporated in twenty-four hours, on again applying water to the edge of the covering glass with a pipette, the worms were as lively as ever."

The extraordinary tenacity of life possessed by the *Tylenchi* (as well as by members of a few other genera of Eelworms), which enables them to remain for lengthened periods of desiccation as if dead, yet still retaining the power of resuming the vital functions on the restoration of requisite moist conditions, was made the subject of investigation many years ago—so far back as 1744—especially with regard to the *Tylenchus tritici*, Bastian, which causes the diseased gall-like growths known as "Ear-Cockles," or "Purples," or "False Ergot," in grains of Wheat, and sometimes also, though more rarely, in those of Oats and Rye.*

But in regard to precise length of time to which it has been proved that this drying process may be continued, and its action on the "Stem Eelworm," the *Tylenchus devastatrix*, in its different stages of life, full information will be found in the report by Dr. J. Ritzema Bos of his own more recent observations.† From these it is shown that eggs of this species not yet arrived at a moderately advanced stage of development,‡ might safely be dried for a period of two months, but if allowed to remain dry for a year, only about a third recovered on

* *Vibrio* (Muller), *Anguillula* (Ehrenberg), *Rhabditis* (Dujardin). See "Mon. on the Anguillulidæ." by H. Charlton Bastian, 'Trans. Linn. Soc.' vol. xxv. pp. 87, 88.

† See 'L'Anguillule de la Tige' (*Tylenchus devastatrix*, Kuhn), par Dr. J. Ritzema Bos. I. Haarlem, 1888. Pp. 86–92.

‡ "Segmentation of the protoplasm" (J. R. B.).

being moistened; the other two-thirds were dead. Eggs, however, of which the contents ("protoplasm") were divided into two, four, eight, or sixteen segments, could not bear desiccation for even six days. After moistening they did not continue to develop. Eggs which had advanced to containing the Eelworm in embryo condition had the power of remaining in the *state* of suspended animation for six months (possibly still longer) without losing the power of re-animation, on application of moisture (p. 88 of work quoted).

The power of the larvæ to regain conditions of active life after desiccation was found to be very great, and the result of the series of experiments made by Dr. Ritzema Bos (see pp. 89–92, *loc. cit.*) showed that after suspended animation during a period of two and a half years they returned to their normal state.

The adult Tylenchi (that is, those in which differences of sex were observable) could not support life under desiccation.

These observations, of which I only extract a small part, are of very practical bearing, as showing that such of the Eelworms or their eggs as are in a stage of life to bear drying may remain safely (to themselves) in straw, or in the surface of the ground, in a dormant condition, or state of "latent life," without needing food, so long as the surrounding circumstances are dry enough for the purpose, and with recurrence of moisture regain their active vitality, and powers of crop injury.

Applications regarding Tulip-root, beginning on May 6th and continuing at intervals during the summer, from widely separated localities extending as far north as Pincaitland, in East Lothian, showed for the most part very marked presence of the characteristic malformation at the base of the stem, and likewise the bad injury caused by the attack.

Tulip-rooted Oat plant.

On June 14th specimens of Oat plants were sent me by Mr. M. A. Streatfield from Chested, Chiddingstone, Edenbridge, Kent, with remarkably characteristic examples of the form of "Tulip-root," in which swelled and distorted side growths, twisting in all directions, are formed at the base of the main shoot, excellently resembling the accompanying figure. The plants sent were about nine inches high. Enquiry was sent accompanying as to the nature of the attack, and whether likely to injure Clover seeds sown with the Oats. "The Oats were got in rather badly, *with a shallow seed-bed*, and were manured with guano. They came up very well, and promised to be a good crop till a few weeks ago; but I now find large patches of plants like enclosed" (M. A. S.). In this case

the preceding crop is not mentioned, but as infestation of Eelworms when remaining in the land, is most especially near the surface, it suggests that the shallow seed-bed mentioned may have had something to do with the attack.

On June 19th a sample of growing Oats from a crop then dying away from something going wrong round the roots was sent me for examination from the Estate Office, Calthorpe, near Rugby. The plants were in a very bad state; some, if not all, had the outer leaves dying and brown, and the plants themselves were still small, at a general estimate only about six inches high.

On July 18th specimen plants of Black Oats were forwarded to me by Mr. C. Ireland Blyth, from Plestowes, Barford, showing remarkably bad attack of Tulip-root, with great quantity of distorted shoots at the base of the stem (see preceding figure). In this case scarcely any of the leaves were more than twelve inches in length. The field from which the plants were taken was mentioned as being very much damaged by some attack "which resolves itself into making the plant as per enclosed."

On Aug. 2nd an application was sent me by favour of Messrs. Webb and Sons, Stourbridge, regarding condition of a sample of Black Tartarian Oats, of which the sender had mentioned that "the crop came on all right until recently, when some disease attacked it, with the result shown by specimen plant." This was the only sample sent me in which the nature of the infestation was only drawn attention to by the swelled or Tulip-bulb-like enlargement of the base of the stems (from which the attack takes its name), unaccompanied by the growth of little spindling shoots, pale in colour, and bent in all directions of their inch or two in length, which often surround the lowest part of the swelled base of the Oat stem.

Later on, on Dec. 20th, I was favoured by the following note of a summer attack, once again to Black Tartarian Oats, being sent me by Mr. T. Carrington Smith, from Admaston, Rugeley. After referring to some recent observations of my own on Tulip-root in Oats, Mr. Carrington Smith observed:—

"You say very truly that this disease has been 'more than ordinarily prevalent.'

"In seven acres of Oats, after Swedes, on land very clean and in excellent condition, the disease destroyed more than half my crop in a very erratic and patchy manner. In the ordinary course of treatment both mineral superphosphate, 3 cwt., and nitrate of soda, 1 cwt., had been applied before the disease was suspected. And in the ordinary course Clover seeds of alternate husbandry had been sown on land through which an apparently good plant of Oats was springing.

"What puzzles me is the fact that the seeds have all along been

splendidly strong, especially the Red Clover. They have given during several months of the autumn a large amount of sheep keep, and they are now attracting large flights of Wood Pigeons, which, as you know, feed greedily on the leaf of Red Clover.

"Now, why is the Clover apparently free from disease on ground where the Oat crop was greatly damaged from Tulip-root? By the way, the Oats were Black Tartarians, from which I expected a very big crop. About thirty years ago I lost a crop of Oats in a similar way, but not on the same ground."—(T. C. S.)

I certainly without more information of previous details cannot say with certainty why the Eelworm should leave the Clover uninfested; but there are two points, either of which might bear on the matter. One is that the Clover was in such remarkably hearty and healthy growth. This is in itself a great help against injury from Eelworm infestation. The other lies in the circumstance that although Eelworms from one kind of crop subject to their infestation can pass, as we constantly see, to another crop similarly susceptible, yet it is matter of recorded observation that where they (the *Tylenchus devastatrix*) have lived for some generations in one kind of plant, that if possible they prefer continuing their infestation to that kind to attacking plants of a different nature.

Some special instances of this in the case of *non*-infestation of Clover, in connection with infested Rye, are given by Dr. Ritzema Bos, in his work previously quoted, p. 73:—"In different parts of Limbourg, where Clover is rarely or never cultivated, the *Tylenchus devastatrix* does not pass into this plant, or at least it is not attacked by the sickness even when it is sown on infested ground." Similar observation is noted to have been made in some other districts, where Rye has been grown for years on infested fields, but Clover rarely or never. "But in countries where Clover is much more cultivated, the plant is not exempt from the attacks of this dangerous nematode" (the Stem Eelworm, E. A. O.).

In this country we are in the latter situation; Clover and Oats are constantly infesting each other to and fro, and the matter is one of practical interest, although in the case of Mr. Carrington Smith's crop I would not without details say what was the cause of the failure.

The Clover-sickness above referred to, which is due to presence of Stem Eelworms, is easily distinguishable from all other kinds of Clover disease, whether caused by unsuitableness of soil, insufficient alternation of crops, mould or fungoid attacks, maggots of the Clover and Pea Weevil at the roots, or other injurious circumstances, by the *definitely deformed growths*.

In the case of Clover "stem-sickness" in the early part of the year, the circumstance of the stalks and branches being shorter and

thicker than in healthy growth, and the buds also themselves being much thicker in shape, is characteristic of attack, and probably various of the stalks and branches will be found dying or decaying; and the Stem Eelworms may be found both in young and mature state in the plants, and very numerously in the buds.

During summer the characteristic malformations are very observable, and I have had specimens sent me in July in which some of the stems with flowering heads were still to be found, but also there were a large number of short barren shoots about an inch long, oval in shape, and with the distorted growth of leaves then merely forming an imbricated or "tile-like" exterior. These shoots were placed closely together, apparently from the growth of each shoot having been stopped.

They varied in number; sometimes as many as five grew on an inch length of stem, one at the extremity and two at each side below, so as to form together a flat fan-like mass. I did not find that they grew round the central stem. They were not all similar in form of diseased growth, but were commonly irregularly and oval or somewhat bulb-shaped; but sometimes they were much prolonged, so as to resemble what is known as a "duck-necked" Onion in shape; and sometimes the lower part of the flowering stem was enlarged for an inch or two at the base. In various of these shoots I found the Eelworms present up to numbers which might be described as "swarming" in the palish brown powdery, or rather granular, matter in the hollow near the base, or other parts of the perishing shoots.

But it is usually the spring or rather the winter condition, of which samples are sent me for identification; and I believe that if the characteristic appearance of these was more generally known, so that remedial applications could be applied in time, a great deal of loss might be avoided.

On Jan. 13th in the past year I received samples from Mr. J. Fairweather, of Havestock, Kelvedon Common, Brentwood, of Clover which had been sown with Oats, and was stated to have grown away splendidly after the Oats were harvested two months before, but then was in the usual condition in which the winter specimens come to my hands. The part of the plant above ground showed the peculiar growths characteristic, as above mentioned, of Clover Eelworm sickness, and also much decay; but still there was a little attempt to establish new growth still going on, showing that if the attack had been taken in time the crop might very likely have been saved.

I am not aware that a good figure has been placed before the public of the malformation to Clover shoots caused by this disease, and if further on in the season, when characteristic specimens are procurable, any of my correspondents would be kind enough to favour

me with a few little pieces showing the distorted buds closely placed on the stems as mentioned above, I should be very glad of the opportunity of having a good figure taken.

PREVENTION AND REMEDIES.—Details of these, with the reasons for the adoption of the preventive measures, have already been given in my Annual Reports referred to below,*—regarding Tulip-root and Clover Stem-sickness, most especially in the three first-named, Field Bean attack in the Fourteenth, and Onion "Eelworm-sickness," chiefly, in that of last year. It is therefore not desirable to go over the details again, but just a general note of points to be considered may be useful.

With regard to spread of infestation.—A large proportion of the Eelworms leave the plants when dying and *drying* (as in Oats, for instance), and go into the surface soil, but some remain in the plants. To get rid of those in the land, common ploughing or digging is of very little service, it only disperses them about. But ploughing with skim-coulter attached, or trenching (true trenching, not mere double digging), will bury them well away. Infested stubble should be dealt with on the same principles. It is no use just lightly ploughing it in, at least it should be collected and burnt, and if circumstances allow of it being burnt standing, it would be a most excellent treatment. This would not only destroy the infestation within the stubble, but would also get rid of many kinds of crop vermin in and on the surface of the land to a very beneficial extent. As before mentioned, in firing stubble a band should be burnt first round the edges of the field, or at least at the edge *towards which the wind drives*, so that the fire may be kept with certainty under control whilst there is still only a very narrow band burning, and this burnt-off surface will quite check the advance of the fire presently, and so prevent indiscriminate spread to the great damage of hedges, or possibly even more important losses.

Returning to infested stubble or fodder: if what is carried from the field becomes mixed (as in litter, for instance) with manure, the Eelworms will in all probability be carried out again to re-infest the fields. It should also be remembered that they may be carried to an amount to do mischief in such surface earth of the infested field as may cling to the boots of workmen or agricultural implements or garden tools. In this manner patches of infestation, such as those mentioned at p. 89, are very liable to be spread.

The principle of such rotation of crops as will not allow one of a nature that is very liable to infestation immediately to succeed another needs no comment. With us, Oats and Clover are the field crops most

* Tenth, Eleventh, Thirteenth, Fourteenth, and Twentieth Annual Reports on Injurious Insects, by Editor.

liable to infestation, but Field Beans are also subject to the attack causing a stunted and deformed growth, such as that shown in the

Field Bean plant infested by *Tylenchus devastatrix*. Natural length, including curve of stem, about ten inches.

accompanying figure, taken by myself of one of a bundle of plants sent me for examination. Of these, the specimen figured above was only

about ten inches in length; another only four; whilst a Bean plant sent accompanying showing the natural length was over three feet and a half.

Onions are also (see my 'Twentieth Annual Report' for details and figures) subject to attack, and lists of other crops which are to some degree liable to infestation, as well as weeds and grasses which serve as food-plants to keep the Eelworms alive in absence of the field crops which they will (if circumstances permit) presently transfer themselves to, will be found in my papers previously referred to, as well as detailed observations regarding applications which have proved trustworthily serviceable for use to ground before sowing, or, *remedially*, to check attack and push on growth.

The following notes are just given merely shortly from the abstract published in my leaflet on Stem Eelworms, of which I should be happy to send copies free to any applicant; and I should like particularly to draw attention to the circumstance that, whilst marked success has attended use of sulphate of potash and some other sulphates named, nitrate of soda has failed, so far as report to myself shows, in producing satisfactory results.

Special applications, which have been found most serviceable for Clover and Oats, whether as preventives, as manure in the preparation of the land, or as dressings to bring a crop over attack, are sulphate of potash alone, as a mixture with sulphate of ammonia, or both of these with phosphates.

Sulphate of potash at the rate of 1 cwt. per acre has had a good effect in stopping the disease and bringing a good crop;—also at the rate of about ½ cwt. per acre it has done well.

As a manurial application, a mixture of about two parts sulphate of potash, three parts sulphate of ammonia, and four parts of phosphates, brought remarkably healthy plants, with few exceptions.

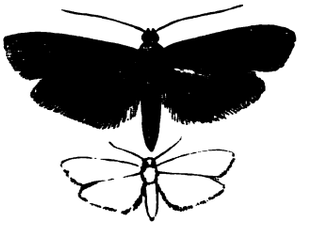
A recipe found to answer well in case of attack in "Tulip-rooted Oats" or "Stem-sick Clover" is—sulphate of ammonia four parts, sulphate of potash one part, and steamed bones two parts; this at the rate of 1½ cwt. per acre, followed up by a dressing of 2 cwt. per acre of sulphate of ammonia.

The following note of experiment in treatment of Clover-sickness at Rothamsted, which I was kindly permitted to use, showed entirely satisfactory results:—"A mixture of sulphate of potash 3 cwt., and sulphate of ammonia 1 cwt. per acre, was applied on April 3rd." The disease ceased, and the Clover made a very vigorous growth, which was continued markedly in the second crop. Sulphate of iron at the rate of 2 cwt. also answered very well both for stopping the disease and giving good growth; at the rate of 1 cwt. the sulphate of iron was not so serviceable.

All measures, whether of treatment of the ground or of liberal and rich manuring, of a nature suited to drive on hearty growth are of use in supporting infested plants if of material suited to its special nature, but nitrate of soda (so far as reports to myself go) has proved nearly or wholly valueless as an antidote to Eelworm-sickness.

STORED GRAIN AND FLOUR.

Mediterranean Flour or **Mill Moth.** *Ephestia kühniella*, Zeller.
Granary Weevil. *Calandra* (*Sitophilus*) *granaria*, Linn. **Rice Weevil.** *C.* (*Sitophilus*) *oryzæ*, Linn.
Hay Mite. *Tyroglyphus longior*, Gervais.



EPHESTIA KÜHNIELLA.—Flour Moth, magnified; outline showing natural size.

The infestations above named have all been entered on before in due course, but as some additional points of serviceable information have accumulated I give the observations under the collective heading of "Stored Grain and Flour," with a repetition of just sufficient of the life-histories of the insects to make the notes intelligible without referring back.

In regard to the destructive flour pest known with us as the "Mediterranean Mill Moth," the researches of various enquirers, both European and American, during the last few years have shown that the existence of this infestation has been known of in different countries for a much longer period than at the first observation of it as an important pest—in the year 1877—was supposed to be the case. Also the distribution of its presence in various countries has proved to be more general; and also, and more recently, it has been recorded from European and American observations that, under pressure of circumstances, the larvæ or caterpillars of this *Ephestia kühniella* moth by no means restrict themselves to consumption of Wheat flour, which is their special food, but will extend it to unbroken grain, and to flour in manufactured and baked condition.

The first observation of this infestation as a serious mill trouble was for some time considered to have been made in 1877, when the caterpillars were found to be very troublesome in the bolting-cloths during the grinding of a quantity of American flour, and moths from these were submitted by Dr. Kühn (Director of the Agricultural Institute of the University of Halle, Germany) to Prof. C. P. Zeller, of Grünhof,* by whom they were found to be a species of *Ephestia* not previously described, and were specifically named by him after their observer—Dr. Kühn—as *kühniella*.

The first recorded observation of the appearance of the attack in this country was, so far as I am aware, in 1887, when moths which had been bred from "Rice-cones" were submitted to Mr. Barrett, and identified by him as a species new in this country, namely, the *Ephestia kühniella* of Zeller.† In the course of the same year "a colony of this scourge of the Mediterranean ports" was discovered by Mr. Sidney J. Klein in some large warehouses in the East End of London, where there were over a thousand tons of flour stored in close proximity, and "the attack spread with great rapidity until one entire warehouse was literally smothered with larvæ, and several hundred pounds worth of damage was done." ‡

Some observations on the attack and some which appeared to refer to it were sent to myself, but it was not until September 15th, 1888, that a complaint was made to me of the infestation as a really serious flour-mill pest, with specimens accompanying, from which I was able to study the attack, and also to rear the moth.

On making enquiries relatively to the presence of this Flour Moth at the Mediterranean ports, I was informed that it was prevalent there where the highly glutenous Russian and Hungarian Wheats were used. How far the nature of the Wheat affected amount of caterpillar was quite beyond me to judge of, although my correspondent was well qualified to be certain as to observable facts. But thinking that, whatever might be the cause of the infestation, the presence of the pest might reasonably be attributed to it being exported with the Wheat from the country which it frequents, I wrote to Dr. Lindeman, the Russian Agricultural Entomologist, on the subject. Dr. Lindeman was good enough to reply at once that he could take on himself to state that up to that time the insect had not been observed in Central Russia, and he was not aware of its presence in Southern Russia.

The recent observations are usefully given by Mr. F. H. Chittenden,

* Ent. Zeit. Stettin, 1879.

† 'The Entomologist' for May, 1887 (No. 288, p. 139). Messrs. West, Newman & Co., Hatton Garden, London, E.C.

‡ Transactions of Entomological Society, part iv. Dec., 1887, p. lii.

Assistant Entomologist of U.S.A. Department of Agriculture, in condensed form as follows:—

"Until the year 1877, when the moth was discovered in a flour mill in Germany, it was comparatively unknown. In later years it invaded Belgium and Holland, and in 1887 appeared in England. Two years later it made its appearance in destructive numbers in Canada. . . . Previous to the Canadian invasion, this moth was generally believed to have reached Europe from America, but, as a matter of fact, the species had not been recognized here until 1889. Danysz * has traced its occurrence in this country as far back as 1880. He mentions also an outbreak in Constantinople in 1872, and presents evidence that it was probably known in Europe as early as 1840. Until the present year this insect was known as injurious on this continent only in Canada and California, but in the 'American Miller' of May 1st, 1895, Mr. W. G. Johnson states that it has appeared in New York State. It is recorded also from North Carolina, Alabama, New Mexico, Colorado, Mexico, and Chile, and probably occurs in Australia." †

The above notes show the rapidity of the spread of this mill pest in the last few years, relatively to which Mr. Chittenden remarks:—"That the Mediterranean Mill Moth has become so formidable in recent years is due to the higher and more equable temperature maintained in modern mills, a condition highly favourable to the development of the insect."

And to give yet another short extract from the same serviceable pamphlet, p. 284, the following note, which adds grain, biscuits, &c., to the dietary of the caterpillars, shows a much greater variety in nature of food than, so far as I am aware, is known of *generally*:—"Although the larva prefers flour and meal, it will attack grain when the former are not available, and it flourishes also on bran, prepared cereal foods, including Buckwheat grits, and crackers." In the same paragraph mention is made of it having been recently discovered as an inquiline (co-tenant) in the nests of a wild Humble Bee in California, and that "Mr. D. W. Coquillett reports that it also occurs in the hives of the Honey Bee."

I have drawn attention to the above by italicising the word "generally," as I am not aware that the great power of the *E. kühniella* caterpillars noticed by Mons. J. Danysz (Directeur du Laboratoire de Parasitologie de la Bourse de Commerce, Paris) of infesting biscuit

* Mons. J. Danysz, Director of the Laboratoire de Parasitologie, Bourse de Commerce, Paris, author of a valuable pamphlet on *E. kühniella*.

† 'The More Important Insects Injurious to Stored Grain,' by F. H. Chittenden, Assistant Entomologist, United States Department of Agriculture. Washington. 1895.

has been generally noticed in this country.* Nor (though to a much less degree) its power of injury to grain. With regard to the latter, an instance is given—p. 22 of pamphlet referred to—of Rye which was left unsold for two years, being found webbed up, and the proprietor, not wishing it to be wholly a loss, feeding it to a number of young pigs, purchased for the special purpose, most of which died consequently on feeding on the almost compactly massed up grain.

The injury to biscuit is recorded as on a very large scale in connection with the army supplies, and amounting at times to as much as half or the whole of the store. The details and statistics of this and the preventive measures requisite are entered on with very serviceable clearness at pp. 23–26 of work referred to.

In an instance under my own observation, which gives some idea of the steady power of multiplication of this species in favourable circumstances, some felted-up flour was sent me on or about Oct. 7th (1895), which then, so far as was noticeable, contained very little infestation, and after keeping this in my study during the winter I found on examination on April 6th in the following year that the mass of flour was webbed firmly together into a piece ten inches long and six wide, and of about an inch in depth in the thickest part, and there were at that date approximately four hundred moths in the box. Some of these were still alive, and from the freshness of their plumage obviously only recently developed, and moths continued to appear until the end of May, when the specimen passed from my possession.

The damage caused by these *E. kühniella* caterpillars spinning up the flour in which they feed, which appears to be the way in which they chiefly hurt us here, is something enormous, from the clots and lumps causing stoppages to the machinery and injurious infestation in every part of the apparatus and of the mill to which flour can have blown. In the words of one of the earliest communications sent me on this subject:—"I have got quite a plague of moths in the mill, some of which, and worms, I send you; they get into the spouts and machinery, and do no end of mischief, both by destroying the silks and stopping the flow of flour, &c., in the spouts by spinning thin web and hanging there." With us this results in losses of hundreds of pounds, and in the United States of America the losses from the same causes, which necessitate frequent and prolonged stoppages, are estimated at thousands of dollars in large establishments.

But it is not only in mills that the damage to flour is serious, for

* See '*Ephestia kühniella*, Parasite des Blés, des Farines, et des Biscuits' [Parasite of Corn, Flour, and Biscuits]: 'Histoire Naturelle du Parasite et Moyen de le détruire,' par J. Danysz. 15, Rue des Saints-Pères, Paris. (All rights reserved.)

the caterpillars, which have an almost extraordinary power of dispersing themselves wherever there is suitable accommodation, are to be found in flour at bakers', and are constantly transported to and fro in sacks of flour, and likewise in the empty sacks which have carried infested flour, and which, when sent on without due disinfection, transmit the pest constantly more and more throughout the country.

The principles of prevention lie in the most extreme watchfulness against infestation being brought in (as above), and most scrupulous cleanliness and care to remove the very first beginnings of moth settlement in the mills. When established, fumigation is sometimes of service, but the danger of the use of bisulphide of carbon, and the risk of injury to the flour which may be stored in the mills in the case of use of sulphur fumigation, is very much against extended use of such measures. In very bad attack the turning on of hot steam, especially where, as in some of the Canadian treatments, arrangements could be made for the steam being "superheated," answers well as a means of getting rid of the trouble; but, at the same time, the temporary injury to the machinery, such as rusting the shafting, &c., the inconvenience of stopping the working of the mill for a time, besides the losses from this and expenses of whitewashings and cleanings of every accessible locality where the caterpillars can lodge, are a serious matter.*

The moth, *E. kühniella* (figured at p. 95) is only about one inch in expanse of the fore wings, which are of rather a pale grey with darker transverse markings; the hinder wings whitish and semi-transparent, with a darker line from the point along the fore edge.

The moths lay their eggs on flour, or on "branny stuffs," or on sacks holding flour, or the like places, and the eggs have been seen to hatch in a few days. The caterpillars, which are about half an inch in length (or a little more), when full-grown, are sixteen-footed, slender and cylindrical in shape, and vary in colour from pale red in the younger to almost white in the older specimens. The head and segment behind the head yellowish brown, the latter divided along the middle by a faint line, and above the last segment also there is a

* Details of the attack and preventive measures which have been attempted will be found in the observations of mill-owners sent to myself, and also in the Bulletin and Report on the Flour Moth issued by the Ontario Board of Agriculture consequently on the first appearance of the *E. kühniella* in Ontario in 1889, and in the Appendix to the Bulletin published at Toronto, October 15th, 1890, of which extracts are given in my Twelfth and three succeeding Annual Reports, these three containing the Canadian references regarding the operations with which I was favoured at the time with much communication. The pamphlet by Mons. J. Danysz, of which the title is given at p. 98, contains such a great amount of useful information that (if permitted by the author) I believe the publication of a translation of it whole or in part would be of great public service in this country.

brownish patch. The jaws are brown. The caterpillars turn to chrysalids in the flour in which they feed, from which the moths may come out in three weeks. The time required for the whole life cycle, that is, through condition of egg, larva, and pupa, up to the perfect insect, varies with circumstances. It may be from two to two and a half months, or, in the most favourable circumstances as to warmth, about five weeks is estimated to be sufficient.

Application for advice as to best methods of extirpation of this pest show the constantly increasing amount of spread in this country; but it is only in the past season that I have received definite observation of it as being transmitted in flour from the south and east of Europe. I therefore give the matter of the two communications, but for obvious reasons without the addresses of the importers. The following observation was sent me on October 31st:—

"I lately received from an Adriatic port two shipments of flour, which, on landing, were both found to be thickly infested on the outside of the sacks with maggots and cocoons, some full, some empty, showing that they must have been the produce of some moth."

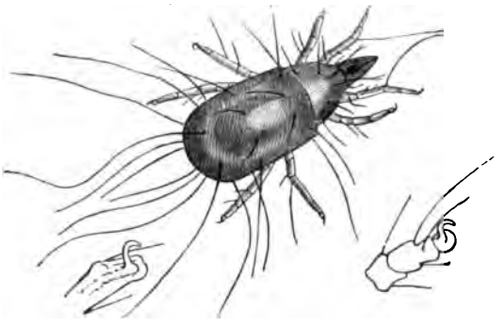
In order to be certain of the nature of the infestation as (in the experience of many years) my correspondent mentioned he had never seen it before, he collected a number of the insects in their various stages of development, as far as they could be discovered, from the sacks of flour, which he forwarded, with the note: "Box A represents the flour, and contains a few larvæ, various cocoons, inhabited and empty, some containing the shell of the pupa after the imago had escaped, and one moth, the only one I succeeded in obtaining, and it unfortunately too much injured to allow of thorough examination"; but, consequently on his study of the subject, my correspondent stated that he arrived at the conclusion that this insect is the *Ephestia kühniella*, and from my own examination of the specimens I saw no reason to doubt such being the case.

The other observation was incidental, and occurred in the course of examination of flour sent me by one of the East London firms, which involved sieving eighty-five barrels of flour, and examination at least of about thirty-five more. In the course of search as to nature of beetles which were or might be present, I came on the clotted-up flour, which is a sign of *Ephestia* presence, and on reporting my observation, my correspondents replied:—"With regard to the Mediterranean maggot we have written the Hungarian mill, calling their attention to its presence, and asking if they can explain."

In the wide distribution which has occurred of this infestation during the past twenty years, it is probably of little practical importance to connect its presence now with imports from any country; but in connection with its common name of the "Mediterranean Mill

Moth," and also the note early in our British observations (see p. 96) of the infestation being especially observed in Hungarian flours, it is of some interest to receive it *directly* from an Adriatic port and also from an Hungarian mill.

"Hay Mite." *Tyroglyphus longior*, Gervais.



TYROGLYPHUS LONGIOR.—*T. longior*, from figure by Fumoze and Robin; claw with sucker of *Tyroglyphus*; right-hand side, from Murray's 'Aptera'; left-hand side, figured by Editor from life. All magnified.

The following observation referring to what is sometimes known as the "Hay Mite" (the *Tyroglyphus longior* scientifically) is the first note I have had of it being observed in connection with oatstacks. This Mite, which is very nearly allied to our common Cheese Mite, is not unfrequently noticed as having fallen from haystacks, or from hay stored in lofts, so as to lie in such great masses round the stacks, or beneath the haylofts, that the quantities of dust-like heaps could be shovelled together, and in one instance an enquirer (although the Mites are not really injurious) had been advised to burn his stacks to get rid of them.

The infestation has been occasionally reported from English and Irish localities, but chiefly from Scotland; but as I have never until last season had any notes of this Mite presence infesting oatstacks, I give the following observation of it with which I was favoured on October 2nd, from Allerston, Pickering, Yorkshire, by Mr. Herbert Prodham:—

"By the same post as this letter I send you a small box containing a quantity of little Aphis or Mites that I have got from our stack-yard. . . . There are twelve or thirteen stacks in the yard of Wheat, Barley, and Oats, but the Mites are only found lying around two stacks of Oats, having apparently dropped out of the ends of the sheaves, and are there in myriads, and in places there is a thickness

of a quarter to half an inch of them, and they have an appearance of brown washed fine sand as seen on a road after a heavy shower, and which first arrested my attention.

"They are under two stacks of Oats grown in two different fields, but they are the *same kind* of Oats—known here by the name of 'Garton Abundance.' We have a third stack of Oats of a different kind of seed, and grown in another field, but there are no insects under it.

"Since beginning to write this letter, I find from the foreman that four waggon-loads of Oats from the field out of which No. 1 stack was built were used in topping up No. 2 stack. Now No. 1 stack has the *most* Mites under it, but still there are more of them under No. 2 stack than can be proportionally accounted for by the four loads. I am curious as to whether the *kind* of Oat has anything to do with it.

"All the three fields in which the Oats have been grown followed Turnips; but the one where no Mites appear is sown with Clover seed, and the other two are not."—(H. P.)

These Mites, of which plentiful specimens were sent me, belong to the order *Acarina*, and are hatched from eggs; in their early condition they have three pairs of legs, when mature four pairs. When seen without magnifying powers they are quite indistinguishable from the common Cheese Mite; but when moderately magnified may be distinguished in a general way by being somewhat larger, also by their longer shape, longer hairs, and their greater activity in movement.

So far as appears from observations up to date, these Mites are mostly found (that is, noticed to an observable and inconvenient amount) in connection with hay which has not been heated, and also made up from what are variously called—according to local custom—cocks, tramps, or tramp ricks, &c., in which, for reasons of weather or otherwise, the hay has been gathered in the fields and left standing for some weeks, or at least for a considerable time, before being stacked.

The following notes illustrate this point. One sent me in 1891 by Mr. Thos. Fraser, from the Isle of Jura, N.B., was as follows:—

"It is the general practice in haymaking in the West of Scotland (West Highlands), as soon as possible after cutting or mowing (which ranges from the end of June to the end of August), to have the hay collected in large tramps or cocks on the field, where it is allowed to remain some time. The first appearance of the Mites (to an ordinary observer) is when removing the said cocks or tramps from the field. While forking the hay from the bottom or lower part of the cock on to the cart, at a much higher elevation, it is necessary to raise the hay *overhead*, and in minute particles, like dust, the Mites fall, and, from the backward position of the worker's head at the time, they stick or

adhere to the face in a very short time, causing itchiness or irritation of the skin. At this stage, I think, they are less in size than they are when found, a fortnight or so later on, emerging from the recently made stacks."

Mr. Fraser also remarked :—

"They have been in Rye Grass and in Meadow Grass this season, but more abundant in the former. During the month of September and early part of October they showed, or appeared to be, at their greatest strength and activity; after the middle of October they gradually showed less vitality to move or extend, until now (the beginning of November) all life is apparently gone."

This kind of Mite certainly feeds in some kinds of cheese,* and is noted by Canestrini as also feeding on other organic substance in a state of decomposition. Elsewhere it is noted as attacking an immense variety of dead and dried animal and vegetable substances; but I do not find any notes of it feeding on living vegetable matter, excepting possibly small fungi. But in some way or other it is obviously in intimate connection with the grass, or with some presence amongst the grass, of which the hay is made, and it would be of interest to trace out this point with proofs.

From Mr. Fraser's remark above quoted, as to alteration in size, the Mites appear at the season named to be approaching maturity. In samples sent to myself I have found young as well as fully developed Mites, as shown by some having only three pairs of legs instead of the four pairs which mark the mature condition.

Why the Mites leave the stacks or lofts where hay is stored in these myriads does not appear, but the accounts agree as to the vast quantities in which they are to be seen on these occasions. In the words of one of my correspondents: "About a month after" [making the stack, E. A. O.] "there were severe frosts (15° Fahr.), and the following day, on each side of the stack, there was a layer, about two inches deep and six to eight inches wide, of these Mites"; and another correspondent wrote: "I could have no difficulty in sending you a peck of them."

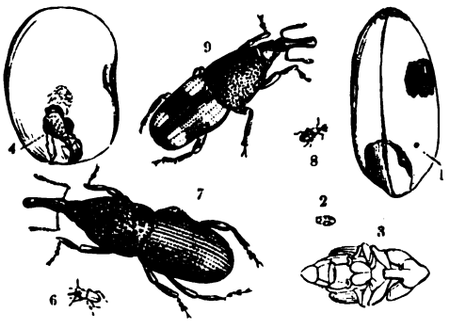
It may be possibly worth notice that these vast emigrations out of the stacks seem to end (as far at least as the observations sent to myself go) by the Mites simply remaining heaped together outside the stack (or loft) instead of being sheltered within. I have not had any observation of their line of march elsewhere being noticed, and if they did remove themselves in numbers corresponding with the vast quantities noticed, these aggregations would (demonstrably) soon be dispersed.

* See, amongst other publications, 'Prospetto dell' Acaro-fauna Italiana,' per Giovanni Canestrini, vol. iii. p. 407. Padova. 1888.

On one occasion they were sent me as being then making their appearance from a stack of Clover saved for seed, in which instance it was said that the stack "was covered with them"; otherwise, so far as I can call to mind, they have always been reported to me from ordinary or Rye Grass hay, and it has not been until the past season that I have had any notice of the Mites being observed in connection with oatstacks.

It has therefore seemed to be of some interest to refer to the infestation again, and, more especially, to give an opportunity of noting that the Mite presence has been found wholly harmless, excepting by reason of sometimes causing cattle or horses fed on the infested hay to cough from the tickling of the throat caused by the Mites in the process of being swallowed.

Common Granary Weevil. *Sitophilus granarius*, Linn.
Rice Weevil. *Sitophilus oryzæ*, Linn.



SITOPHILUS GRANARIUS and S. ORYZÆ.—6, 7, Granary Weevil; 2, 3, Chrysalis, natural size, and magnified; 8, 9, Rice Weevil, natural size, and magnified; infested grains, also magnified.

Corn Weevils are amongst the injurious insects which are constantly more or less present as a cause of much loss in imported cargoes of grain, and of a great deal of inconvenience, even where it may chance the loss is not great, in granaries and amongst stored corn generally.

During the past season enquiries have been sent me especially regarding the creatures as granary pests, and as to means of clearing the beetles (which we succeeded in doing to some degree by a very simple plan), and also regarding their presence in stored flour.

The term "weevil" is very apt to be applied to any small beetle (or, indeed, other kinds of small insects) which are found in grain, flour, or biscuits; but the term is only rightly applied to beetles, and,

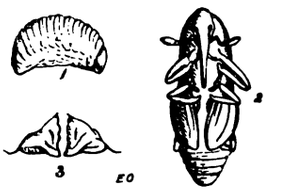
amongst beetles, only to one section, that of the *Rhyncophora*, or "Snout-bearers," which have the head furnished with a snout, or proboscis, sometimes short and broad, sometimes, as figured at p. 104, long and slender, and arched or bent from base to tip.

The two kinds of weevils which trouble us as stored grain infestations in this country were formerly known as *Calandra*, but now (with us) more commonly as *Sitophilus*, and are *Sitophilus granarius*, more especially known as *the* Granary Weevil, and *S. oryzæ*, the Four-spotted Granary Weevil, which, though called the "Rice Weevil," is mischievous in Wheat, Barley, Oats, and other kinds of grain.

The two kinds of weevils are very similar in appearance, both as to size and in variations of tint of brown or pitchy colour, excepting that the "Rice Weevil" usually is rather the smallest, and is distinguishable (see figure 9, p. 104) by having two lighter spots on each wing-case. Also, whilst the "Rice Weevils" possess ample and serviceable wings folded beneath the wing-cases, the Common "Granary Weevils" are wingless. The length of the "Granary Weevils" is from about one and a half to two lines, that of the "Rice Weevils" commonly rather less; and the general colouring of both species is some shade of pitchy black or pitchy red, or even sometimes pale chestnut; the antennæ (horns), which are elbowed and inserted on each side of the proboscis, are reddish, and the legs also are reddish. The fore body more or less pitted, and the wing-cases striate. At the end of the snout is the mouth-apparatus with which the weevils make the holes into grain for egg deposit.

The life-history (taking the Common Granary Weevil as having been most observed) is as follows. The female beetle makes a hole with her proboscis in a grain, and in this she lays an egg,—one egg only in small corn, such as Wheat, Barley, or the like; but recent observations have shown that in the case of Maize, or Indian Corn, more than one egg is deposited. It is considered that in the course of a week one female can lay up to as many as one hundred and fifty eggs. The young maggot, which soon hatches, feeds on the contents of the corn grain, clearing it all out so as only to leave the outside, and there it changes to the chrysalis state, and thence shortly to the perfect weevil.

The larvæ or maggots of *both species* are legless, white, fleshy and thick in shape (as shown in the figure accompanying), with yellow or chestnut-coloured heads, and strong jaws. In the case of the Rice Weevil maggots, the jaws were chestnut-coloured, and bluntly pointed and waved into two blunt teeth.



Maggot and chrysalis, and jaws of maggot of Rice Weevil; magnified.

The rate of multiplication of the weevils is variously stated, and probably is much influenced by circumstances, and most particularly whether the temperature is raised to the height favourable to development. One record of observation of time taken by the *Calandra* (*Sitophilus*) *granarius* for development from egg to beetle is forty-one days, another is of thirteen weeks; and it is stated that this species will not pair in a temperature of under 52°. In a case of some observations of my own as to development of Rice Weevils extending over fourteen months, during which I kept the infested Wheat in a living room, used in winter as well as summer, I only obtained one brood.

It adds very much to the destructiveness of this infestation that the *beetles as well as the maggots* feed on grain of different kinds, as Wheat, Oats, Barley, Rye, Maize, &c.; and with regard to the "Rice Weevils" the variety of food which they attack is thus stated:—

"The adult beetles attack a great variety of food products *not affected by the larvæ*. When abundant in storehouses and groceries they invade boxes of crackers, cakes, yeast cakes, macaroni, and other bread-stuffs, barrels and bins of flour and meal, and can subsist for months on sugar. They are even said to burrow into ripening and over-ripe Peaches, Grapes, and Mulberries, and to attack Hemp seed, Chestnuts, and table Beans." *

During the past season I received from one of our East London importing firms a consignment of various kinds of beetles which had been found in flour, for identification, and amongst these were specimens of the *Calandra* (*Sitophilus*) *granarius*. There is no reason, so far as I am aware, to suppose that these weevils lay eggs or live in maggot state in flour, still their presence is objectionable in any case, and especially to importers, where, under the rules of the Merchant Shipping Provisions Act, even the presence of very small numbers in a barrel of flour causes its rejection.

In this instance the eighty-five barrels of flour had to be emptied, the flour sieved and repacked, destroying all foreign matter. The infestation was exceedingly small in amount, as the weevils collected from the above amount of large barrels only amounted to about enough to half fill a small phial. In itself (save for breach of regulations) it would have been unimportant, but, entomologically, the observation was of some interest.

The weevils sent me caught my attention as varying to some slight degree from the typical form of Granary Weevil (*Calandra* (*Sitophilus*) *granarius*), and to be absolutely sure of the species I submitted them to Mr. O. E. Janson, of Great Russell Street, E.C., who was good

* 'The More Important Insects Injurious to Stored Grain,' by F. H. Chittenden. See note, p. 109.

enough to examine them and reply as follows:—"The *Calandra* I at first thought might be distinct from the *granaria*, L., but now I have examined a larger series, I find there is some variation in the form of thorax and other points, and therefore conclude it is that species."—(O. E. J.) The "Rice Weevil" was also just represented.

On further communication with the docks, it was stated that oil-cake next to which the flour had been stored was swarming with weevils. The oil-cake had lain there eighteen months, and apparently had formed congenial quarters. This point I had not the opportunity of examining on the spot myself, but looking at the long time for which these weevils will live, certainly for months, and it has been stated, by various observers, for more than a year, there is no reason to doubt that the stored cake might be used for harbourage, and serve as a centre for spread of mischief, although not for breeding purposes, and the great inconvenience which arose suggests that search as to what may be present in storage localities before sending in large amount of valuable imports, would sometimes be of more use than is generally thought of. And also that in a case like this it would be well not to allow a weevil centre to remain undisturbed for months.

As pests in corn cargoes, and in grain stores, and in granaries down to the smallest where grain can be stored, we have long been well acquainted with the mischief caused by these weevils; but I just add one of the notes of their presence sent last year showing them as a trouble in the winter stock of food laid up for horses. This was sent me on September 29th:—

"I shall be much obliged if you can inform me how I can get rid of weevils which have appeared in great numbers among my Oats in my granary, not a large one. I have about fifteen quarters of Oats in stock. The weevils run about them and up the walls and ceiling. I have tried spreading some of the Oats on the floor thinly, and then fumigating the granary with brimstone, as in cases of fevers, or dirty houses, &c. However, this seemed to have no effect on the weevils, though the room was kept closed all night, but they were as lively as possible next morning on the walls, &c. I thought of putting the Oats on a malting floor, but I was told that the heat required to kill the weevils would spoil the Oats. Any suggestion you can make I should esteem of great value, as these Oats are my winter stock for my hunters."—(H. A. W. N.)

Prevention and Remedy.—In the above-mentioned difficulty the chief point desired is to get rid of the weevils, and in the course of the past season I suggested trying for this on a small scale, the plan which is described as follows on a very large one in unloading infested cargoes:—"When the cargo is very badly affected,—when the whole

bulk seems alive, as I have myself seen them on very hot summer days,—it is a common practice for merchants to spout it—*i.e.* to shoot the grain down a spouted trough, in which, at the angle, is a wire sieve with meshes large enough to let the weevils pass through, but not the corn, which runs into the granary or into sacks, as the case may be.

"By such means the quantity of weevils and dust sifted out is enormous; and this appliance is generally so situated at the wharves that the beetles are deposited near the edge of the wharf, or even in the river bed, and if not naturally washed away at high tide are swept into the water, their destruction being thus easily accomplished.

"The great heat generated in a bulk of weevilly corn is caused by the dust arising from the borings and 'frass' of the insects. The weevils themselves are generally to be found inside the granaried heap or cargo of corn, unless the weather is very hot, when they are especially lively on the outside."—(E. A. F.)*

On a small scale there does not seem to be any difficulty in carrying out this plan as well for farm use, or in private establishments, as in the great shipping arrangements; and last season I suggested running weevilly corn down a screen made especially for the purpose so as to allow the beetles to go through but not the corn, and I was told that the plan succeeded. The great point to be attended to would be that the weevils should fall on what they cannot escape from, but a tub or rather a shallow vat of the length and breadth of the screen, and placed beneath it with a mixture of soft-soap and paraffin in water, or anything which would stifle the beetles, would answer every purpose, and not be of much expense.

As matter of prevention of infestation, fresh grain should never be stored in bins where infested grain has been, or in buildings where weevils are then present, as they have a power of spreading with wonderful rapidity. All bins in which weevilly corn has been stored away should be cleared of all remains of the grain and thoroughly scrubbed, brushed, and cleaned in every available way.

Lime-washing and scrubbing granaries (especially with soft-soap), plastering up all crannies and uneven wall surfaces so as to prevent the weevils sheltering in them, and for a similar reason concreting or asphalting all uneven floors, are measures strongly recommended. Also where storage rooms or granaries are large and steam power is available, it might be expected that the application of steam by means of a hose, and at the greatest heat attainable, would act well in clearing out this attack, as it has been found to do in mill service for clearing out the "Mediterranean Mill Moth," and also such of the

* From "Granary Weevils, *S. granarius* and *S. oryzæ*," by Edward A. Fitch, 'The Entomologist' for February, 1879, pp. 42–43.

cheese vermin which shelter between the boards or other crannies in large cheese rooms.

The use of the dressing machine or blower is also recommended to clear the infested grains.

In regard to the application of heat as a disinfectant.—It is stated that Wheat can be subjected to a temperature of 150° without destroying its germinating power, and (without acting on this save with due experiment) it may prove that this would be a serviceable way of destroying the weevil maggots in the grain, which are very hard to reach by most methods of treatment.

In regard to fumigation generally, or deterrents by means of strong vegetable or chemical scents, the utility of a large proportion is very doubtful.* Also some that in themselves are, or might be, useful as insecticides, as sulphur, for instance, or naphthaline, are of limited use, from their capability of injuring the nature of the flour, or imparting so strong a scent to the grain as to make it undesirable for food.

The fumigant, of which the use has been steadily gaining ground both in the United States and in Canada for many years, is bisulphide of carbon. Of the method of application of this I have given notes in previous Annual Reports in extracts from the Bulletins or Reports of the Ontario Board of Agriculture; but the following extract from Mr. Chittenden's pamphlet contains serviceable information, both as to the nature of the application, and likewise the *great danger* from its inflammability, and also the *risk to health and even to life* if carelessly used:—

"*The bisulphide of carbon.*—The simplest, most effective, and inexpensive remedy for all stored grain insects is the bisulphide of carbon. This is a colourless liquid with a strong disagreeable odour. It vaporizes abundantly at ordinary temperatures, is highly inflammable, and is a powerful poison.

"The most effective manner of applying the re-agent in moderately tight bins consists in simply pouring the liquid into shallow dishes or pans, or on bits of cotton waste, and distributing about on the surface

* For a list of these, under the heading of "Repellants, Counter-odorants, and Lure Traps," see Mr. F. H. Chittenden's pamphlet on 'The More Important Insects Injurious to Stored Grain,' referred to in note, p. 97. This pamphlet of about twenty pages is strongly to be recommended to all interested in insect grain attacks. It gives short accounts of about twelve grain or flour infestations, giving the most important points connected with them, and also figures of the greater number, and to these are added about four pages of remedies. It is in my opinion an excellently useful work, and where any intending purchaser should have difficulty in procuring it from his own bookseller, probably from the connection of Messrs. W. Wesley & Son, 28, Essex Street, Strand, London, E.C., with the special subject of supplying American agricultural publications they would have no difficulty in supplying it or procuring it.

of the grain. The liquid rapidly volatilizes, and, being heavier than air, descends and permeates the mass of grain, killing all insects, as well as rats or mice, which it may contain.

"The bisulphide is usually applied in tight bins at the rate of a pound to a pound and a half to the ton of grain, and in more open bins a larger quantity is used. . . . Bins may be made nearly air-tight by a covering of cloths or blankets. Oilcloth and painted canvas are excellent for this purpose.

"Mills and other buildings, when found to be infested throughout, may be thoroughly fumigated and rid of insects by a liberal use of the same chemical."

Mr. Chittenden here notes, amongst other things, that the doors and windows should be closed as tightly as possible, and a *watchman* stationed without to prevent anyone from entering the building, and he also gives the very necessary caution that the building should be thoroughly aired early in the morning before the return of the workmen.

To continue the extract from Mr. Chittenden's paper :—

"It is best to begin in the lowest story and work up, in order to escape the settling gas. . . . The bisulphide is usually evaporated in vessels, one-fourth or one-half of a pound in each.

"Infested grain is generally subjected to the bisulphide treatment for twenty-four hours, but may be exposed much longer without harming it for milling purposes. If not exposed for more than thirty-six hours its germinating power will be in no wise impaired. In badly infested buildings it is customary to repeat this treatment about every six weeks in warm weather."—(F. H. C.)

The bisulphide treatment has long been considered as one of the most valuable methods of disinfection both in Canada and the United States, but I have hesitated to bring it forward on account of the danger both to human health and even life, and also the great danger to property consequent on its extreme inflammability, unless used with both care and knowledge.

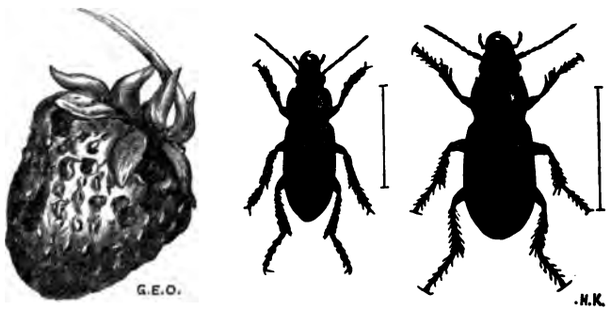
How far its use may vitiate an insurance I do not know, but it will ignite in temperature heated up to a certain point even in the absence of light from fire, lamp, &c., and even the light of a cigar will or may cause ignition; and in experiments of my own I have seen a specimen dressed with the fluid ignite merely from exposure to the sun's rays in the open air.

One other point remains to be noticed, and that is infestation by means of screenings from foul corn, sold cheap, carrying infestation around in the neighbourhood of mills. These, according to their nature,—as the small broken bits of straw sold for pigs' bedding, the mixture of small shrunken Wheat, with broken grain and chaff, sold

for feeding poultry, or the very miscellaneous collection of bodies larger than corn grains, sometimes known as "rubble,"—may or do spread pests wherever they are taken, and are to be looked on with great suspicion.*

STRAWBERRY.

Ground Beetles—"Bat Beetle." *Harpalus ruficornis*, Fab.; *Pterostichus* (*Omaseus*) *vulgaris*, Linn.



HARPALUS RUFICORNIS (left hand), and PTEROSTICHUS VULGARIS (right hand), magnified, with lines showing natural length. Strawberry fruit gnawed by *H. ruficornis*.

In the year 1894 accounts were sent to me of much mischief caused by various species of "Ground Beetles" (duly identified at the time) to Strawberry fruit at Woodborough in Nottinghamshire. In this instance the farmer watched for the cause of the mischief, and detected the beetles swarming on the fruit by night, which they devoured to such an extent that the crop of three roods was ruined.

In 1895 the attack reappeared to a much more serious extent, for it showed itself at many places in the above district, and injured the Strawberry fruit to such an extent, just when it was beginning to ripen, as to cause severe losses.

In 1897, that is, the year now past, the specimens and reports forwarded show this great trouble to Strawberry growers to be not only still present and injurious in the district where it was first observed, but also to be much more widely prevalent. In this county (Hertfordshire) the beetles appeared in great numbers in the early

* See my 'Twelfth Annual Report on Injurious Insects,' article "Screenings," pp. 56–65.

part of June at two localities, respectively, about two and a half miles in a north-easterly and two miles in a south-westerly direction from St. Albans, and also elsewhere in the district. In Norfolk they were reported in two localities. In Nottinghamshire they reappeared as again seriously mischievous. In Bedfordshire they were reported from one locality as a great trouble on a large acreage, with the remark that it was believed to be a general complaint. I had also information of the total destruction of a fruit-grower's crop near Tewkesbury, Gloucestershire, and similar destruction of three-quarters of an acre near Ringham, Berks.

A glance at the position of the above localities on a map will show the widely increased prevalence of the pests over the country.

The species of "Ground Beetles" sent me during 1897 for identification were the *Harpalus ruficornis* and the *Pterostichus* (*Omaseus*) *vulgaris*, figured at p. 111, magnified, with lines showing full natural length, which is somewhat variable.

The *Harpalus ruficornis* is 6–7 lines long, pitch black, with the long horns and long legs usually red; the thorax is thickly punctured at the base, and the hinder angles acute; the wing-cases are faintly striated, and are thickly covered (whilst the specimens are fresh) with golden or greyish down. *Beneath the wing-cases are ample wings, which they use freely for flight.*

The *Pterostichus vulgaris*, also figured at p. 111, is rather larger than the foregoing, and is 6½–7½ lines, or possibly more, in length. Wholly black, and rather shining. Thorax rather broader than long, hinder angles bluntly pointed; wing-cases strongly and smoothly striated. *No wings.*

Descriptions of other species of beetles of which specimens were sent me as injurious to Strawberry fruit in 1895 will be found in my Annual Report for that year.

These beetles belong to a section (the *Geodephaga* scientifically) which, quoting from Mr. Rye * as a leading authority, "superficially may be known by their active habits, slaughtering propensities, thin legs and antennæ, and hard outer covering. They . . . may be considered as the carnivora of the beetle race; passing their lives, both in the larval and perfect state, in the pursuit and destruction of their weaker insect brethren. . . . The larvæ of the *Geodephaga* are but little known; they are, however, mostly found in the same places as the perfect insect, and are equally carnivorous and active. A geodephagous larva is usually flat, elongate, parallel-sided, fleshy, with the head and first segment hard; . . . the legs are horny, six in number, and situated on the first three segments; . . . there are powerful sickle-shaped jaws, and the apex of the body has usually

* 'British Beetles,' by E. C. Rye, pp. 44 and 46.

two horny or fleshy appendages on its upper surface, the lower part being lengthened into a membranous supplemental leg. The pupa is generally (if not always) formed in a cell underground, and is rarely met with."—(E. C. R.)

Some of this section, however, have been found during the last few years to be also vegetable feeders to an injurious extent, and in the case of the two kinds mentioned at p. 111, anyone who wishes to see for himself that they are both Strawberry and animal feeders may satisfy himself by keeping some specimens without food until they are hungry, and then introducing food into their cage.

In my own experiments I found that on dropping a few worms among the hungry beetles that one of the *Pterostichi* seized a little worm for its own special prey, setting its legs firmly so that it could drag the creature along, whilst most of the rest of the beetles made a simultaneous attack on an earthworm which was about four or five inches long, and settling themselves in little parties with their heads opposite to each other, pulled with their strong jaws until they soon tore through the skin. They also eat uncooked as well as cooked meat and cooked fish.

I found that both kinds preyed greedily on Strawberries, and a party of the *Harpalus ruficornis* lived for seventeen days on nothing but Strawberry fruit without, so far as I could see, suffering in any way from this diet; but neither of the two kinds of beetle would apparently even taste any of the other kinds of fruit which I placed in their jar.*

The damage caused to the Strawberry crop is by attack of the beetles both to the green and ripening, and also the ripe, fruit. With the green fruit they will even clear the skin; and with the ripe fruit they are particularly partial to attacking the seeds, and likewise gnaw large or small holes, as the case may be, in the substance of the fruit (see figure, p. 111), so that the fruit in all probability turns moist and rots, but certainly is quite ruined for purposes of sale.

The first information sent me regarding observation of Strawberry "Ground Beetles" in the course of last year was given me by Mrs. Broadwood, of Bone Hill, St. Albans, a friend and neighbour, who, on June 14th, brought me over a number of specimens, which, on examination, proved to be *Harpalus ruficornis*. These were part of such a very numerous appearance that it was described as a swarm, of which so many fell at 10 p.m. on the previous evening on members of the family sitting in front of the house, that it was supposed the beetles were tumbling from the roof. A search was going to be set on foot as to possible lurking-places, but the weather turned colder,

* For minute details of experiments, see paper on "Strawberry Ground Beetles" in my 'Nineteenth Annual Report.'—E. A. O.

and the beetles did not reappear in this manner, but were mentioned to be all about the neighbourhood, and especially reported by a gardener living close to a wood near Park Street. This is a village about a mile (as the crow flies) south of St. Albans; Bone Hill is about two miles to the south-west.

Later on, enquiry was made me by the Rev. J. A. Cruikshank, Vicar of Sandridge, a village not quite three miles to the north of St. Albans, as to the nature of a very great quantity of large dark brown beetles which had appeared in June, and completely destroyed his very promising Strawberry bed. On showing Mr. Cruikshank my type specimens of Ground Beetles, he picked out those of the *Harpalus ruficornis* as similar to those which had done the mischief, and at my request was good enough to give me the following note of the great numbers in which the beetles appeared, and the great amount of mischief which they caused:—

"The *Harpalus ruficornis* made its appearance in this way early in June. I noticed a sound as of heavy drops of rain falling on the step of the garden door; on inspection, I found that the sound was caused by scores of beetles falling from the walls of the house; apparently they had flown against the wall and then fallen to the ground. About the middle of June my gardener noticed great numbers of them on and about the Strawberry bed; they remained in the soil during the day, and came to the surface at night. They first attacked the Strawberry beds when a few berries were ripe, and then turned their attention to all the berries, whether green or ripe. The whole crop, an exceptionally good one, was destroyed in less than a week. After they had done all the mischief they could, they disappeared, but a few are still to be found in the soil at the date of this letter."—(J. A. C., Sept. 20th, 1897.)

A little later than the date of the above appearances of the *H. ruficornis* to the north and south of St. Albans, I found a small amount of injury to Strawberry fruit in my own garden, which lies on the southern slope of Holywell Hill in St. Albans, just outside the town; but I did not notice presence of any beetles, possibly because I was seldom in the garden in the evening.

On July 6th I was favoured by the Rev. T. E. Platten, writing from Hindringham Vicarage, Walsingham, Norfolk, with the following communication, showing, like the preceding one from Sandridge, the speed and thoroughness with which a visitation of these beetles (*H. ruficornis*) clears off a promising crop of Strawberry fruit:—

"I am sending for your inspection some Strawberries gathered from my bed. I had a most splendid show of fruit, and now I find that nearly all the berries are like those I am sending, and there is not a Strawberry on the bed worth eating. I am also sending you in

the box some specimens of beetles with which our house is this year infested. Is it likely that the damage to the Strawberries is done by the beetles? . . . I may mention that I have heard of several other cases of the destruction of the Strawberry crop in the same way in this neighbourhood."

The beetles sent me by the Rev. T. E. Platten proved to be specimens of the Strawberry "Ground Beetle," the *Harpalus ruficornis*, and on furnishing them with ripe Strawberries, they attacked the fruit as I had seen on previous occasions. One patch of five-eighths of an inch long by about half that breadth was eaten away on the outside of one fruit; and in another case one of the beetles fairly buried itself in a large hole which it gnawed right through in a fruit, the end of the tail of the beetle showing at one end, and the head coming out just beneath the calyx at the other.

On July 9th Mr. Platten wrote further regarding the beetles:—

"My man and I yesterday searched a crack in the ground in the Strawberry bed, and in about a foot or eighteen inches found a dozen. There were two kinds, one the same as those I sent, *Harpalus ruficornis*, and the other a larger and blacker beetle, but there were only two or three of these.* The ground in many places is covered with a powdery dust,—the seeds eaten off the berries. As to the cause;—no town manure has been used on the beds or anywhere in the parish, I feel sure. The bed is infested all over, as far as I can see; about one-third was newly planted last autumn, the rest was not dug, but there does not appear to be any difference in the number of beetles. It is not due, I think, to the scarcity of moles, I seldom knew them so numerous as last year. Last autumn, in two of the fields near, I noticed several times very large flocks of starlings, and I thought then that there must be a very plentiful supply of food of some sort for them. I do not know whether there could be any connection between the two things. . . . I find the beetles do eat one another; a dead carcase is greedily attacked at once."

In regard to possibility of poisoning the beetles by a mixture of red lead made up into a paste with flour, which had been mentioned as sometimes answering for destroying beetles, Mr. Platten wrote me on July 12th:—

"Red lead has no effect upon the beetles. I mixed flour, dripping, and the lead into a paste, and gave it to some in a box; they at once devoured it greedily. That was on Saturday. This morning (Monday) they are as lively as ever."

* Conjecturally, these beetles might be *Pterostichus vulgaris* or *P.* (*Steropus*) *madidus*, both of which species are black, and somewhat larger than the *H. ruficornis* (see p. 111); but as I had not specimens for examination, I cannot be certain.—E. A. O.

The following note from Mr. S. B. Burroughes, one of my regular correspondents for several years, shows presence of beetle attack on Strawberries at yet another Norfolk locality,—Cley-by-the-Sea, Holt.

Relatively to some injury which was going forward amongst root crops apparently similar to damage sometimes caused by one or more kinds of "Ground Beetles" to Mangold plants, by biting them off just beneath the surface of the ground, I was at the time in communication with Mr. Burroughes, who examined the beetles carefully, and told me that they were of the kind I named (*i. e.* Ground Beetles of one of the kinds named above), and he further added:—

"The same beetle has been most destructive amongst the Strawberries this year; . . . I had seen them before, but had no idea they eat vegetables."

On July 13th, in reply to my enquiries, I was favoured by the following short note of continued presence of the attack from Mr. M. J. R. Dunstan, Director of Technical Instruction for the County Council of Nottinghamshire, who in 1894 and 1895 had forwarded me information of mischief caused by Ground Beetles to Strawberry fruit at Woodborough in the above county (and in 1895 also to other places in the district) to a serious extent. Mr. Dunstan wrote:—

"In reply to your letter, the attack of the beetles on the Strawberries this year, though not so bad as in previous years, is yet very serious, acres of good fruit being spoilt by being nibbled so as to render it unsaleable. Locally, the attack is put down to the destruction of moles, which seems to have been indulged in generally. Your account of other attacks is very interesting; it seems as though the pest is spreading."

On October 21st the following observations of beetle damage to Strawberries were sent to me by a large firm of nurserymen in Bedfordshire, whose address I have not given, as they would prefer it omitted. The specimen forwarded was of the *Pterostichus vulgaris* (see figure, p. 111), one of the kinds of Ground Beetles which is known to attack Strawberry fruit, and which may vary in size from just a little over half an inch in length to about three-quarters. Messrs. —— observed:—

"Last summer we were also much troubled (and we believe it was a very general complaint) with the ravages of a black beetle, a small one of which we beg to send you herewith. As you will see, it has eaten the seed only of the unripe fruit, and we found large quantities of green fruit so attacked, simply the seeds being hollowed out; but this caused the fruit not to swell." [It was mentioned that many of the beetles were larger than the specimen sent.] "We have tried catching them by means of basins let in level with the ground and baited, and have caught a considerable number; but as we have a

large acreage, this is a slow and expensive process. . . . They seem very retentive of life, as some lived in water for two or three days. They appear to lie dormant in the winter, and come out again in the spring."

From a fruit-grower near Tewkesbury I had the following enquiry during the autumn, which appears (although I had not specimens sent for identification at the time of the attack) to refer, without doubt, to the same infestation.

"Will you kindly inform me whether I can apply anything to my Strawberry beds to kill or drive away a small beetle commonly called in this neighbourhood the 'Bat Beetle'? In colour it is of a dull black, with reddish brown legs; and it eats the surface of the growing Strawberry, continuing from the time the fruit is just beginning to swell until it is ripe. My crop was totally destroyed last season through this pest. The soil in my garden is a rich sandy loam. There are plenty of moles, which I encourage to destroy beetles, grubs, &c."

A few days after, on receipt of such information as I was able to furnish him with regarding method of "Ground Beetle" attack to Strawberries, my correspondent replied:—

"I think it has furnished me with the reason why my crop of Strawberries should be entirely ruined and my neighbours' plantations should be *almost* entirely free. The variety of beetle that I found in my beds, according to the description, is the winged variety (*Harpalus ruficornis*); and as they are a carnivorous beetle, I can quite see that I have been attracting them from all over the neighbourhood, as I have been using blood fresh from the slaughter-house for my fruit trees on each side of the Strawberry plats, and as I discontinued the use of it as the warm weather came on, the beetles remained to eat the Strawberries."

During December I received the following communication from West Ringham, Berkshire, with specimens of the beetle which had caused the damage in the preceding summer accompanying:—

"I grow about three-quarters of an acre of Strawberries for sale, and last season the fruit was all spoilt by little beetles, such as I now enclose (which were glossy black on the back with red legs); they seemed to eat the seeds, and then the fruit withered away. I did not gather a bushel off the whole place. . . . They were not to be seen on the surface in the daytime, apparently burying themselves about an inch underground, but at night they were very busy. The ground between the plants has now (Dec. 31st) been dug, and we saw nothing of them; but perhaps the eggs are there. . . . I may say both early and late kinds were equally affected."

The specimens, which were in very good order, so that they still preserved the somewhat golden down on the wing-cases, agreed well

both with descriptions and with my type specimens of *Harpalus ruficornis*, and on lifting the wing-cases the large wings folded beneath them were very observable.

Summary.—On looking over the notes of practical observation, there are several points worth notice.

One is that—of the various kinds of "Ground Beetles" of which we have as yet had definite report, from identification of specimens, as attacking Strawberry fruit—*one kind only is serviceably winged.*

This is a very important matter, as in the case of attack from wingless kinds it is plain that the beetles must either have been bred on the place, or must have been brought in in manure, or in some way transported on to the ground either in egg or in maggot, or in some stage of beetle life, and therefore it might certainly be hoped that, by attention being paid to this matter, the feeding material of the maggot and the depth at which it works below the ground might be discovered, and thus the grubs might be got rid of before the time arrived for them to go through their changes to their Strawberry-destroying beetle state.

For description of the general characteristics of the larvæ (grubs) of "Ground Beetles," see p. 112.

With regard to the winged kind: this is the Harpalus ruficornis, and those who will be at the pains to unfold the wings from beneath the somewhat downy wing-cases, will find them large and well-developed organs of flight.

I am not aware of our having had observations until the past season of this species appearing in what were described as "swarms"; but in the case of the great numbers which were noticed at Bone Hill, near St. Albans, at 10 p.m. (see p. 113), I had personal opportunity of identification of them as being the *H. ruficornis;* and just about the same time they were observed (see p. 114) falling by scores, as if they had struck the house wall in their flight, at Sandridge, about five miles distant from the first-named locality.

So far as our observations of this past year and of 1895 show, the Ground Beetles, of which the species most reported is the *H. ruficornis*, begin their work in the evening, and their capability of coming in great quantities and so late as 10 p.m., would give a reason why the most scrupulous endeavours to clear out the infestation of such unaccountably large numbers of beetles were found useless.

In one of the special reports of 1895 by Mr. Rice,* he mentioned:—"The beetles are without number, and seem most active an hour after dark, being full and dormant at break of day. . . . The beetles

* See my 'Nineteenth Annual Report,' p. 85.

lie round the plant and under the earth, which is covered with straw and litter, having their holes and runs through the earth and litter, the opening being through the litter, and just under the bunch of fruit attacked."—(W. R.)

At Sandridge, in the past year, it was observed: "They remained in the soil during the day, and came to the surface at night."—(J. A. C.)

At Hindringham, Norfolk, my correspondent mentioned: "My man and I yesterday searched a crack in the ground in the Strawberry bed, and in about a foot or eighteen inches found a dozen."—(T. E. P.)

Another correspondent from near Wokingham, Berkshire (p. 117), noticed: "They were not to be seen on the surface in the daytime, apparently burying themselves about an inch underground, but at night they were very busy."

These various notes point to them as being regular night feeders, and the name of "Bat Beetles" given them in one locality draws attention so serviceably to their evening and nocturnal appearances, that I have added it at the heading in addition to the scientifically accepted name of "Ground Beetles" for this whole section of *Geodephaga*.

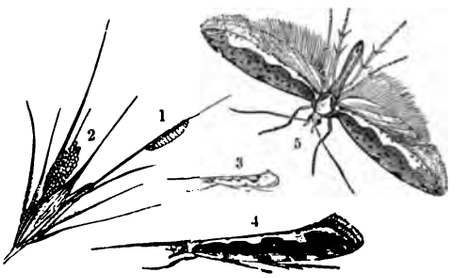
Measures of prevention and remedy which could be brought to bear on a broad scale are greatly needed. The most successful treatment appears to be putting down pieces of flesh covered with bits of thick sacking; this is said to attract large numbers, which can easily be removed and killed each morning. Another plan of trapping is to sink vessels below the ground-level, into which the beetles fall, and are killed by some destructive mixture within. Also, from the way in which they have been found in large numbers on the surface of water, it might be worth trying whether they would be attracted by means of pans of water placed on the Strawberry beds.

Opinions appear to differ as to serviceableness of moles; from the wing-cases of the beetles being found in the rejectamenta of the moles, there appears to be no doubt that they devour the beetles if so disposed, but there is no mass of evidence as to benefit from their presence. The only way in which to get at the pests in the ground really serviceably appears to be watering with some chemical which would not be hurtful to the plants, but be destructive to the pest in its pupal state, in which it is lying unprotected by any hard skin, and also unable to move, shortly before its change to beetle condition. There might be a chance of this doing good, just as by sprinkling kainite the development of one or two kinds of insects may be checked very beneficially.

But at present we do not, I believe, know the exact appearance of the Strawberry beetle larvæ, or of the pupæ, nor where they lie, nor how long they take for their changes, and we are greatly needing more information to check the increasing prevalence of this destructive pest.

TURNIP.

Diamond-back Moth. *Plutella cruciferarum*, Zeller.



PLUTELLA CRUCIFERARUM.—1, caterpillar; 2, eggs; 3, Diamond-back Moth (all natural size); 4, 5, Diamond-back Moth, at rest and flying (magnified).

During the past year there has been once again some amount of mischief from infestation of caterpillars of the Diamond-back Moth on leafage of Turnips and Swedes; but this has been nothing to compare in magnitude with the attacks of 1891 and 1892, nor so widely prevalent as that of 1894, which, though not of any great importance, was present at a good many localities, from the edge of the New Forest in the South of England to as far north as St. Andrew's and Anstruther, Co. Fife, N.B., and to the neighbourhood of Aberdeen.

But, as was the case with previous attacks, such small amount as there was last year was mostly on land in the neighbourhood of the sea-coast. The district of Ballachulish is on Loch Leven and Loch Linnhe (an inlet of the sea), in the West of Scotland; Seafield and Aberdeenshire generally, in which county the Diamond-backs did a good deal of injury to the Turnip crop, is nowhere far from the sea; and Arbroath (Co. Fife) is on the sea-coast in the East of Scotland. The only English observation sent was from near Scarborough on the sea-coast in Yorkshire.

The first communication was sent me on July 14th by Mr. W. W. Anderson, from Ardsheil, Ballachulish, Argyleshire, N.B.:—

"The enclosed is, I believe, a Diamond-back caterpillar. I found

it on a field of Swedes to-day. As in 1894, my attention was drawn to this field by the constant presence of Gulls. In addition to the Herring Gull, Common Gull, and Kittiwake, I noticed a few Black-headed Gulls, an uncommon variety in this district,

"The Turnip leaves are very much cut, but I have not been able to find many caterpillars. For the last two years we have not been affected by this pest, and the Turnip fields have been unoccupied by Gulls; so that everything tends to confirm my previous proposition, namely, that the Gull is in search of the caterpillar.

"I fear, however, that the remedy is rather drastic, for the Swede leaves in some places are badly cut, suggesting the nip of a bird's beak rather than the ravages of a caterpillar.

"P.S.—I have omitted to mention that although the Swedes and Yellow Turnips are both attacked, and the Gulls are feeding indifferently amongst both kinds of roots, it is only the Swedes that have apparently suffered from the birds' bills. Have the Gulls greater difficulty in removing the caterpillar from the Swede leaf than from that of the common Turnip?"—(W. W. A.).

The sample sent was of Diamond-back Moth caterpillar, then beginning to spin up, and in all probability, the attack being for the most part come to the stage of spinning for change to the chrysalis state, would be the reason why, although so much damage had been done, yet at the time so few caterpillars were observable on the leafage. The thin whitish webs of the chrysalis cocoons are not nearly so observable as the green caterpillars. In the sample sent me the web was completed by Sept. 17th, the day after receipt, and was so fine and open that I could easily see the characteristic markings on the pale head, and on the next segment, through it.

On July 20th, Mr. Anderson favoured me with a further note that in the course of further examination he had come across a few more caterpillars, and that most of the Gulls had left the field, although a few still remained; and that it appeared as if no further damage had been done to the crop (at least to any appreciable extent) since date of his previous letter.

On July 20th, in course of examination of some Turnip leafage sent to me by Sir William Gordon, Bart., of Earlston House, Kirkcudbright, N. B., relatively to a much distorted growth conjecturally caused by injury from *Cecidomyia* (Gnat-midge) larvæ, I found a few specimens of caterpillars of Diamond-back Moth present, although the leafage sent had not been much eaten. The caterpillars were full, or nearly full grown, and still of a beautiful apple-green colour.

On Aug. 21st the following observation was sent me, with specimens of Diamond-back caterpillars about fully grown and cocoons in

some instances containing the partly developed moth accompanying, by Mr. John Browne, from Peasiehill, Arbroath, Co. Fife, N.B.:—

"As the leaves of the Swedish Turnips in many fields in this district are getting badly destroyed, I forward you some of the affected leaves; underneath the leaf you will notice the insect in the cases.

"When they come out of the case and are disturbed they drop down on a slim cord to the ground."—(J. B.).

Enquiries as to the name of the pest, and circumstances favourable or otherwise to its increase, were added.

In this instance the caterpillars were apple-green and about full-grown. The cocoons were attached to the leaf, and in some the change of the chrysalis to the perfect moth was so far advanced that the form of the wings folded beneath the body could be clearly seen, and colouring had begun. As in this attack the condition of the infestation was manifestly (from the various specimens sent me) passing from caterpillars in their active condition to the spun-up state, it is probable that those noticed as leaving their cases or cocoons had only just begun their spinning operations.

The leaves forwarded were not very much injured, but the characteristic method of injury of Diamond-back caterpillars, by gnawing away the under part of the substance of the leaf and leaving the upper cuticle as a film, was quite noticeable.

The following observations regarding a somewhat severe attack of the same infestation in a district near Aberdeen was sent to me on Sept. 15th by Mr. H. Simmons, from Monaltrie Villa, Seafield, Aberdeen, N.B.:—

"Having noticed that a great number of fields of Green-top Yellow Turnip in this district were suffering from some kind of blight, I carefully examined a lot this morning, and found that the damage was being caused by a very small green caterpillar which attacks the foliage. I have taken the liberty to send you per parcels post the top or leaves cut from one of the above-mentioned Turnips, also a few specimens of the caterpillars."—(H. S.).

Enquiries as to nature and means of prevention of the attack were added.

The specimens sent were very characteristic. The caterpillars, which were numerous, were for the most part nearly or quite full-grown, of an apple-green, the head pale and spotted, and the segment behind the head with very minute dots. The body of the caterpillar with a few black bristles, and the caudal prolegs spreading apart. Some of the caterpillars had woven their long light cocoons almost entirely by the midrib (as far as I saw) of the Turnip leaves, and the chrysalis or moth was quite distinguishable through the open network.

Some pieces of injured leaves were sent to show the kind of damage, and likewise the leaves taken together with a slice of the top from one Turnip. There were above fourteen in number, and most of them about twelve inches long. These showed much damage from the caterpillar gnawings, the workings being as is usual from the back of the leaf, so as in some cases to leave (in patches) only a film of the upper skin, and sometimes towards the end of the leaves they were a mere ragged mass composed of remains of the skin, and the veins, which were too hard to be eaten.

Mr. John Milne, writing to me from Inverurie, Aberdeenshire, on Oct. 20th, also mentioned that the larva of the Diamond-back Moth had done considerable injury to the Turnip crop in the county, and affected the weight of the crops very considerably on some fields.

On Sept. 1st and 4th Mr. H. E. Donne, writing from Court Green, Cloughton, Scarborough, mentioned that a seven-acre field of Turnips, of which he enclosed samples of leafage, was infested by two or more kinds of insects, and was beginning to turn yellow.

Much damage was done to the leaves, of which a portion consisted in the lower part of the skin being eaten away, as in the case of attack of caterpillars of the Diamond-back Moth; and my correspondent mentioned that he found the caterpillars closely resembled the drawing of that of the Diamond-back Moth which I sent him. But in this instance I found a condition which looked so like the chrysalis cocoon mouldering away, and thus natural causes preventing recurrence of attack, that it may be worth while to mention it for future investigation.

Beneath some of the leaves there were small white patches, which from their size, situation, and general shape looked like the cocoons of the Diamond back Moth; but on close examination appeared to be masses of white mould, often with brown matter in the middle. The whole mass was easily detachable from the leaf, this showing that it was not a growth from the surface. So far as I could make out, it appeared as if from some circumstances the grub or chrysalis in the cocoon had died and mouldered into a brown mass, and the white fungoid or mould growth had developed on the cocoon into the small masses, looking at a glance like the still perfect cocoon. More examination when specimens may be more numerous might give us serviceably interesting information as to one method at least of failure of autumn continuation of propagation.

The above notes give little more than report of observation of the presence of this serious Turnip pest, but are desirable to record relatively to possible reappearance in the coming season; and amongst some amount of special observation it will be seen (p. 121) that various kinds of Sea Gulls were again visible on the infested land, thus drawing

attention to the mischief that was going forward, and also helping to lessen the amount. The white bodies beneath infested Turnip leaves, having the appearance of cocoons covered with mould, and with the contents in brown decay in the centre, are also worth attention.

The habit of life of the Diamond-back is for the female moths for the most part to lay their eggs on the under side of the leafage of the attacked plants, as Turnips, Swedes, Cabbage, Charlock, or allied crop-plants, or weeds.

The caterpillars, when full-grown, are about half an inch long, and somewhat spindle-shaped, that is, taper towards each end. The colour is variable, but commonly of an apple-green, and when near full growth the head is usually grey or yellowish, and marked with small black dots, and the next ring has a number of very minute black specks. When young the caterpillar is often yellowish or greyish, with black head. Each of the first three segments bears a pair of claw feet, and there are four pairs of sucker feet beneath the body, and another pair which are set out slantingly from each other at the tail. When alarmed the caterpillar can let itself down by a thread, up which it returns again at pleasure.

Where severe attack is present, it may be distinguished from other insect mischief by many of the leaves being what is termed "lace-worked." The caterpillars feed on the under coat of the leaf, so that to a certain extent the upper coat may often be found remaining merely as a thin film. But very often, from the caterpillars not feeding on the veins of the leaves, these will be found remaining, with the thin connecting upper coat of the leaf so broken away in drying that the network of veins greatly resembles a piece of coarse pale brown lace, and the appearance may be taken as a guide to the kind of infestation that has done the mischief.

The caterpillars spin up in about four weeks from hatching, and form cocoons on the under side of the leafage of their food-plants, or in any convenient place on or near it. These cocoons are often of such a mere open network that the form of the chrysalis can be seen through the web of threads. The time spent in chrysalis state may vary a good deal, as from rather over one to about three weeks; *the chrysalids from the last brood of the year remain in this state through the winter.*

The size of the moths is only about or rather under two-thirds of an inch in the spread of the wings, and to ordinary observation they appear as brownish-grey moths, about the size of "furniture moths," but long and narrow in shape. When at rest, and the upper wings laid along the back, with the edges meeting, the pale patterns along these edges form diamond-shaped marks, whence the English name

"Diamond-back Moth"; if seen sideways, the curved-up extremity of the wings, as shown at 3 and 4 in the figure, is very striking.

PREVENTION AND REMEDIES.—Such measures as were found serviceable in the great attack of 1891 were entered on fully in my Annual Report for that year, and also in my Official Report to the Royal Agricultural Society as their Consulting Entomologist; and the main points of these are embodied in a leaflet on this infestation, of which I should be happy to send copies (free) to any applicant.

But it may be noted that one important point is to keep watch for the very first appearance of attack, so as to be able at once to make requisite applications to keep up the strength of the plant under the injury.

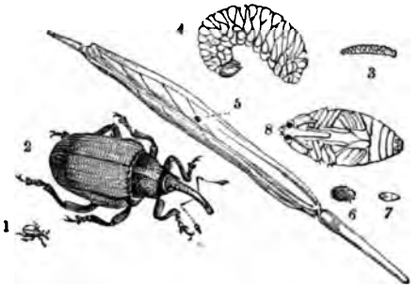
Of the various recipes sent, one that was named on trustworthy authority as answering well during bad attack of 1891 was an application of 10 cwt. soot, 8 cwt. nitrate of soda, and 1 cwt. ammonia, mixed well, and sown broadcast by hand, whilst the dew was on the leaves, at the rate of 1 cwt. per acre.

Nitrate of soda and soot mixed were mentioned as very useful, where there was rain to soak the application down; also the use of nitrate of soda at the time of singling, the worker sprinkling a little as he goes along, and so the effect being greater than in broadcasting.

Use of scufflers with boughs fastened on them to brush the caterpillars down (*which fall on alarm*) does good, but the great point is by every possible means to keep up the strength of the plant till the time of feeding of the caterpillars is past.

It is well said, when attack is about, that the caterpillars, being on the under side of the leaves, there are great difficulties in the way of getting at them by sprayings or dressings of any kind; but if we can by any means induce a growth which will counterbalance the daily ravage of the grubs, we have a good chance of carrying the crop on until the infestation lulls off in course of nature into the chrysalis state.

Turnip-seed Weevil, *Ceutorhynchus assimilis*, Payk.
Turnip and Cabbage Gnat Midge, *Cecidomyia brassicæ*, Winn.



CEUTORHYNCHUS ASSIMILIS.—1 and 2, beetle; 3 and 4, maggot; 7 and 8, pupa (all natural size and magnified); 5, infested Turnip pod.

THE following paper is inserted not so much with a view of entering on the life-history of the Turnip-seed Weevil, which has already been given, but to draw attention to some very special points of difference in the methods of the attack of the maggots of this weevil to the seed of Turnips and Swedes; and those of the maggots of the Turnip and Cabbage "Gnat Midge," the *Cecidomyia brassicæ*, which, from comparison of observations previously sent with samples of attack forwarded to me during the past two years, I conjecture at least to share the damage to unripe seed in the pods with the Turnip-seed Weevil more than is generally known of.

Taking the habits of the Gnat Midge grubs first, these are found towards the end of May and in June in the seed-pods of Turnip or other plants of allied kinds in great numbers, where they suck the juices from the seeds. These infested pods do not ripen properly; they swell at the attacked spots, become prematurely yellow, and split open, so that the mature maggots fall out and bury themselves to turn to chrysalis state in the ground. The little gnat-like flies, which are not as much as one-twelfth of an inch in length (1·25 mm.), appear in about ten days, and presumably start a new generation.

The method of attack of the maggots is similarly described by Dr. J. Ritzema Bos* in the following words:—"They suck out the juice of the unripe seed, which is thus destroyed before the time for maturity is arrived. The pods swell at the maggot-infested spots; they ripen and wither sooner than those that are healthy, and burst, and the larvæ fall to the ground, where they pupate. In about ten days swarms of little gnats make their appearance. These certainly

* 'Tierische Schädlinge und Nützlinge,' von Dr. J. Ritzema Bos. Berlin, 1891, p. 588.

again lay eggs on the pods to be found at the upper part of stems of Rape or other cruciferous plants."

Another point which is especially noticeable in the habits of these Cecid maggots is the great numbers in which they live together in the infested pods. They have been recorded by continental observers to live up to as many as from forty to sixty in one pod, and in the observations sent me in 1896 by Mr. W. Sim, of Gourdas, Fyvie, Aberdeenshire, he found as many as thirty.

For many years I have been in receipt of pods more or less distorted, and showing premature yellowing and splitting open; but it was not until 1896 and 1897 that I was able to thoroughly observe the complete difference in the method of attack of the two kinds of maggots under consideration to the seed itself.

In October, 1896, Mr. W. Sim, writing to me as above from Gourdas, in Aberdeenshire, forwarded me specimens and careful notes of the attack of the larvæ of a Cecid to Turnip seed in the pod, which agreed so thoroughly in all respects with that of the *Cecidomyia brassicæ* of Winnertz, that it appeared to be obviously of that species.* The imagines, that is, the developed Gnat Midges, being, however, dried and somewhat injured, Mr. W. Sim, on the repetition of the attack in July of the past season, sent me again a large supply of infested pods, in the hope that I might rear the Gnat Midge. I was unfortunately unsuccessful in this matter, but the pods sent me were so greatly infested not only by Gnat Midge maggots, but also by those of the Turnip-seed Weevil, that I was able to compare the method of working, and to secure a few observations of the manner in which the latter destroys the seed by straightforward consumption of the contents, which, though alluded to in some degree by entomological writers, is not, so far as I am aware, well known practically.

It was on July 5th, 1897, that Mr. Sim wrote me as follows:—

"The insect-pest which was so destructive to my Turnip-seed crop last year, and which you described and named for me *Cecidomyia brassicæ*, threatens to be even more serious this year"; and on examination I found great numbers of Cecid maggots present, some of which were then leaving the pods.

But on further examination a day or two after, I found that besides the Gnat Midge maggots there were also a number of Turnip-seed Weevil maggots present, which were busily at work destroying the seeds. One (apparently full-grown) was working with its brown head inside a seed which it had cleared out, whilst a collection of wet green rejectamenta lying at the caudal extremity showed that the work of destruction was then going on. In another pod I found a much younger weevil grub which had recently begun to attack a seed, and

* See my 'Twentieth Report on Injurious Insects,' pp. 148–152.

had only made a small progress into it with its little brown jaws. In another instance the beetle-grub had its head by the remains of the skin of a seed, and in another the larva was eating so diligently that it was not disturbed on the pod being opened; and in this instance also the maggot was lying together with the wet green rejectamenta.

When the two attacks were thus under observation together, the very distinct methods by which the seed in the pods was ruined, or the contents devoured, was very striking. In the case of the Cecid maggots their *suction* of the unripe seeds destroys them before the time of ripening, and I found many of the seeds shrunk and sunk in, especially at one part of the surface—in fact, blighted and aborted in growth; whilst in the case of the weevil maggots, I found them, as noticed above, in the act of clearing out the contents of the seeds, and so busy at their work as not always to be disturbed from it on the pod being meddled with. I also found the dividing membrane down the middle of the pod gnawed into holes, and in one pod as many as five of the still remaining seeds were gnawed by the weevil maggots.

In the account of his own observations given by John Curtis in his 'Farm Insects' (p. 105), he particularly notices this not being mere injury, but *consumption* of the seeds by the weevil maggots. He mentions:—"Three pods were forwarded to me, each being punctured, and on opening them I found only one seed untouched, and two that were but slightly eroded; others were half-consumed, and many entirely eaten up; a hard gummy substance of a dark colour enclosing the spots occupied by the maggots, which might be the dung compressed by the animal." As Curtis's specimens were obviously in a later condition than mine, it seems evident that this gummy substance was the dried state of the wet green matter which I noticed was being excreted where the weevil maggot was then feeding.

The maggots are of the shape figured at p. 126, fleshy, legless, much wrinkled across, and yellowish white in colour, with pale brown heads. These larvæ fall to the ground on premature opening of the infested pods, and bury themselves in the ground, where they are stated to form an earth cocoon for their change of condition, from which the little weevils may be expected to begin to appear in about three weeks.

In the case of my own specimens from pods received on July 5th, I found, on examining the collection on Aug. 3rd, that there were a good many of the little weevil beetles already developed, perhaps about six or eight, but their great activity made it difficult to take observations whilst they were alive. If allowed to pause (as on the edge of their jar) they would without delay expand their wings and fly away, and whilst in captivity would run, if undisturbed, with great nimbleness, or, if disturbed, would immediately drop down.

The weevils are not quite the sixth of an inch long, including the proboscis (see figure, p. 126). The colour is black when the specimens are old or have been rubbed, but when freshly developed the coating of fine white or greyish hairs gives them a grey appearance. There may be two broods during the season. The last lives through the winter, and when the beetles come out they feed on the flowering shoots of Turnip, Mustard, or allied plants, and Rape is especially recorded by continental observers as being attacked.

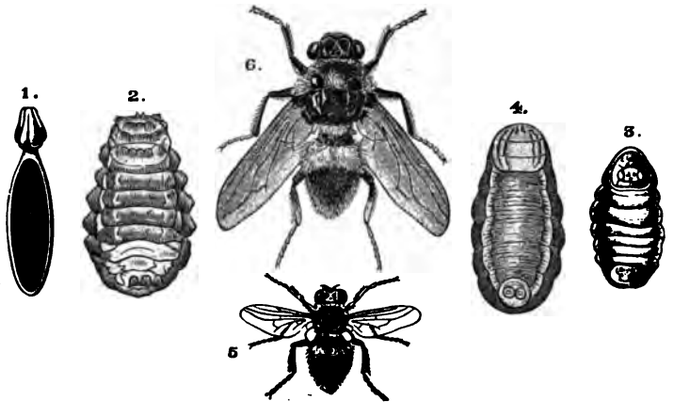
Consequently on its various methods of injuriousness, this weevil is only too well known as one of our regular crop pests; and in 1891, which was one of the years in which it was specially observed in company with the Turnip-flower Beetle, the mischief caused by the joint attacks near Kelvedon, in Essex, and Cardington, Bedfordshire, was severe.

In that year Mr. John Moss and Mr. Geo. Malden (of the above localities) were good enough to place in my hands notes of treatment which to some degree lessened the amount of mischief from these two kinds of beetle infestations, and which are given, with details of the habits, and likewise figures of both kinds, in my Annual Report for that year.

But the *Cecidomyia* attack appears to be confined to *suction* of the unripe seeds, and if some of my correspondents in the coming season should be kindly disposed to send me some specimens of prematurely ripening Turnip pods, I think it might be of serviceable interest to find whether this little Gnat Midge attack is not more generally distributed than is at present known of.

OX WARBLE FLY, OR BOT FLY,

Hypoderma bovis, De Geer.



1, egg; 2, maggot; 3 and 4, chrysalis-case; 5 and 6, fly. 3 and 5, natural size, after Bracy Clark; the other figures after Brauer, and all magnified.

During the past season much application has been made to myself regarding warble prevention. I have received from upwards of two hundred and fifty to three hundred letters on the subject, these including many applications for copies of my four-page leaflet on Warble, with requests sometimes for one copy, but in a large proportion for numbers for distribution, up to as many as a thousand. I have also distributed, approximately, a thousand copies of my 62 pp. abstract of information from my previous reports on Warble Fly, and have had great pleasure in copies of this being accepted for distribution to the students at the Royal Veterinary College, the Royal Agricultural College, and other important centres of special work.

The only additional recipe for destroying maggots in the warbles which has been brought forward (so far as I am aware) besides those which we—that is, those practically concerned in warble prevention—have known now for fourteen years as answering well for the purposes required, is the application of dry salt by rubbing it into the openings of the warble swellings. From the report of the Technical Instruction Committee of the Staffordshire County Council, bearing date August 14th, I gather that the experimental application was only tried on an exceedingly small scale; but doubtless, as well as the long known treatment of dressing with brine, might prove serviceable.

Also, consequently on the careful attention which I have endeavoured to give the subject of warble prevention since 1884, application

has been made to me from various quarters that I would come forward *publicly* as advocating it being made compulsory that all owners of warbled cattle shall dress the warbles in some satisfactory manner during the spring, and that the police should see the order carried out.

In regard to writing to the Press on this subject, I should consider (as I do not hold any official position) that I should be taking a very great liberty in endeavouring thus to bring action to bear as requested on the Board of Agriculture, more especially as I gather from Press notices that the Board of Agriculture has been applied to and declined to act.

But in my own publications the case is different, and here I hope I am not presuming in saying that, though we all are perfectly aware that far more action is needed than is as yet taken by a large proportion of farmers with regard to destruction of warbles at the season when they are most prevalent, and also in application of preventive dressings in summer, I have no hesitation in stating that I believe it is demonstrable, from both farming and statistical records and entomological data, that the practical extinction of the Warble Fly in this country, in which it has long been thoroughly established, by any measures whatsoever, is NOT *within the bounds of possibility*.

So fully do I believe this that, so far from desiring to aid in petitioning for compulsory measures, I should think myself much more justifiable in suggesting to all owners of cattle that they should be on the alert, and, if it came to such a point, that they should earnestly petition that they should be left undisturbed by compulsory interference with their property.

In regard to data on which opinion can be formed on this matter, it appears to me to rest much on knowledge of two leading points :—

1. How far warble maggot is to be found present *throughout the year*. This is of vital importance in the consideration.

2. Where the plan of destruction of maggots in the spring has been carried out as we have trustworthy record of it having been done regularly for thirteen years in one district, what has been the result?

Once again I beg most respecfully to submit that I only give my own views consequently on having been so repeatedly pressed regarding the matter; but I lay the following notes from information in my possession before my readers that they may judge for themselves how the matter stands.

The first portion of the subject entered on, it will be seen, is the condition of the warble maggot during the year in connection with the cattle; next, some market reports showing date of presence in hides; and thirdly, extracts from communications given me (duly

acknowledged in all cases) regarding amount of warble injury, from which I have now chiefly taken the dates of presence.

The following notes give observation of dates of first appearance of warble maggot in condition large enough to be perceptible to the naked eye; also dates of first general appearance of the warble as a swelling or opening; and also of the time when the maggots were noticed to be leaving the animals during the months of 1884 and 1885 in which information was sent me, from which I formed my first report on Warble Fly. I give the dates of the months only, the year being less important.

On November 8th a piece of infested hide was sent me by Messrs. C. and H. Hatton, Barton Tannery, Hereford, as showing first symptoms of presence of warble maggot. This piece of hide was about 12 in. by 4 in., and on the *flesh side* there were upwards of seven slight swellings about a quarter of an inch across, of a livid or bluish colour, each forming a raised centre to greatly-inflamed patches. Within the blue centre I found a small warble maggot, just large enough to be distinguished by the naked eye when removed. This is the earliest state in which I have had the opportunity of seeing the maggot-workings beneath the hide.

On January 27th Mr. John Dalton (tanner), Wigton, Cumberland, wrote:—"I have to-day noticed, for the first time this season, the appearance of the young warbles. I found them in two different hides (both off young cattle of from one to two years old). . . . *The round hole in the hide is distinctly visible.*"

The first reports of observation of *general* appearance of the warble as a swelling or in open condition began at the middle of February; on the 14th (from Glendonagh, Midleton, Co. Cork) the lumps were reported as increasing in number and size; and on the same day examination of the cattle at Spurstow Hall, Tarporley, Cheshire, showed that some of the warbles appeared as soft lumps gathering to a head.

On the 18th Messrs. Hatton (tanners), of Hereford, wrote me that they had received an Ox hide with many warbles in it (specimens of which were forwarded), by presence of which the value of the hide was deteriorated in value from 35s. 5d. to 29s.; and on the previous day Messrs. Hatton had informed me that "notice had already been given that hides on Birmingham Market would be sorted for warbles, and those having more than three would be out-classed."

On the 20th I had the opportunity of examining warble myself in young but open state in the hide of a Hereford removed that day from the animal.

On the 23rd, report from Ballinacourte, Tipperary, Ireland, noted that warble had appeared on some of the cattle.

On the 25th, Mr. Thompson, M.R.C.V.S., Aspatria, Cumberland, wrote me that he had examined a large number of young cattle rising

two years old, and found them well covered with the warbles in various stages, "some of them have twenty enlargements on the back, all showing the external opening."

Mr. H. C. Haines (tanner), Newport, Mon., wrote me:—"I seldom see much of the warble in the pelts excepting during March, April, and May. . . . I usually commence to notice them as April comes in; for about a month I should judge fifty per cent. were damaged."

In regard to dates up to which warble maggot was still present on infested animals, also date of escape of the maggots at the end of what may be called the ordinary maggot season, Mr. Hy. Thompson wrote me from Aspatria on May 15th :—" I examined a byre yesterday near the sea, and failed to find a single warble. Next place I went to the cattle's backs were nearly covered. The grubs are leaving the animals very fast now in this district."

On July 9th following, Mr. John Dalton (tanner), of Wigton, Cumberland, wrote:—" At the present time hides are almost free from warbles, the worm having in almost every instance escaped. The last three weeks is the period (this year and in this part of the country) when the creature has made its exit."

The above notes of observation of presence of the infestation show the maggot (with the guide to its presence of the inflammation caused by it in the under surface of the hide) to be large enough to be noticeable in November, and the external swelling of the warble, in some instances already open in the centre, to be noticeable in January; general appearance of warbles to begin about the middle of February; attack to continue during March, April, and May; maggots noticed to be leaving the cattle about the 15th of May, but still so far present later on that the three weeks preceding the 9th of July is noted as the chief time (in the observations then being taken) during which the maggot had made its exit.

These dates may be considered as showing the general range of period of warble presence, irrespective of presence of egg or maggot in its very earliest condition, which dates necessarily from the time of the Warble Fly laying its eggs, popularly "striking" the cattle, which is variable; and also of casual presence between the middle of July and the commencement of observable development of the new attack of warbles in autumn or early winter, of which I had very complete specimens, including passage through the hide, in November.

The two following tables, and the remarks accompanying, give information regarding a portion of the period—in one case of seven weeks, in the other of thirty-two weeks—in which warble attack was found present to such amount on hides as to be matter of regular business record. For this information I was indebted to the courtesy of Messrs. Fry & Co., Leather and Hide Factors, Moor St., Birmingham.

The following table, it will be seen, gives the weights of the six classes of hides reported, together with the number of sound and of warbled hides in each; also the reduction on warbled hides per pound, and per hide, and the consequent loss in each class.

Particulars of seven weeks' supply of six classes of hides, being the total of each class of sound and warbled sold at two markets in Birmingham, commencing May 3rd up to and including June 14th, 1884, *and showing the actual loss of each class of warbled hide:—*

Six Classes of Hides. Weight from	Hides. No. of sound.	Hides. No. of warbled.	Sold at	Per Hide less than the sound.	Loss on each Class. £	s.	d.
95 lb. and upwards	286	67	¾d. per lb. or	6s. 3d. per hide	20	18	0
85 lb. to 94 lb.	446	222	7/8d. ,, ,,	6s. 7d. ,,	73	1	6
75 ,, 84 ,, ...	754	373	1d. ,, ,,	6s. 8d. ,,	124	6	8
65 ,, 74 ,, ...	881	579	1d. ,, ,,	5s. 10d. ,,	168	17	6
56 ,, 64 ,, ...	629	441	1d. ,, ,,	5s. 0d. ,,	110	5	0
55 lb. and under ...	283	224	1d. ,, ,,	4s. 3d. ,,	47	12	0
Totals.....	3279	1906		Total.....	545	0	8

The reader's attention is particularly directed to the proportion of warbled hides, which amounts to nearly two-thirds of the number of sound hides, showing the great prevalence of warble maggot still remaining during the seven weeks, inclusive, from May 3rd to June 14th.

The following table is an abstract of particulars of sound and warbled hides sold at one of the three Birmingham markets from February 14th to September 19th, 1885. The detailed information which I have given in full in my Annual Report for 1888 and elsewhere contains in column form returns for each week of the period named of amount of sound and of warbled hides sold in each of the classes named, with price of each.

Abstract of table, with particulars of eight different classes of hides sold during warbled season of thirty-two weeks from February 14th to September 19th, 1885.

Weight and Description of Classes of Hides.	No. of Sound Hides.	Highest and Lowest Prices per lb.	No. of Warbled Hides.	Highest and Lowest Prices per lb.
95 lb. and upwards	621	5d. to 6d.	68	4½d. to 5¼d.
85 lb. to 94 lb. ...	911	4¾d. ,, 5⅜d.	138	4⅜d. ,, 4⅞d.
75 ,, 84 ,, ...	1495	4½d. ,, 5⅜d.	306	4d. ,, 4⅜d.
65 ,, 74 ,, ...	1789	4d. ,, 4⅞d.	541	3⅝d. ,, 4⅛d.
56 ,, 64 ,, ...	1692	3⅞d. ,, 4⅞d.	497	3½d. ,, 4⅛d.
55 lb. and under ...	873	3¾d. ,, 4¾d.	305	3½d. ,, 4⅛d.
Heavy cow-hides ...	1193	3⅞d. ,, 4¾d.	140	3½d. ,, 4d.
Light cow-hides ...	1382	3⅞d. ,, 4⅝d.	151	3½d. ,, 3⅞d.
Totals ...	9956		2146	

Careful study of the detailed (folding) tables, from which the above is abridged, is well worth while for those practically interested. They show the different time over which attack extends from February 14th, and that it certainly cannot be considered as stopping in July. We find it in the three lighter classes of hides *as still present on Sept. 19th*, but it is worth some notice that three heavy classes did not contain warbled hides at a much earlier date. The heaviest ox-hides, 95 lb. and upwards, were free after May 30th, and the two others of these heavy classes were free (save two hides in one class and one in the other) respectively after June 27th and July 18th.

To the above I add some short notes of duration of warble from information given me by the secretaries or managers of various of our hide or butchers' societies or companies specified.

"We should say that during the months of March to August inclusive there will be fully 60 per cent. of the hides more or less affected, with an estimated loss of 2s. 6d. per hide average."—JAMES WATSON & SONS, Hide Market, Whitehall Road, Leeds.

"Warbles begin to show in March and continue until October."—W. B. WELBOURN, Secretary, Nottingham Hide, Skin and Fat Market Company, Limited.

"We reckon the warbled hides to be—in the month of February, 20 per cent.; in March, 45 per cent.; in April, 30 per cent.; and in May, 20 per cent."—Messrs. WHINYATES, WEBSTER, McNAUGHT & Co., Hide, Skin and Fat Brokers, The Market, Gill Street, Liverpool.

"The Bristol slaughter of beasts would be about 700 per week, and during the summer and autumn months fully one-third of this number would be warbled."—WILLIAM WILLIS, Bristol and Western Counties Butchers' Hide and Skin Co., Limited, 88, Thomas Street, Bristol.

"I have no means of ascertaining definitely, and can only approximate the following results:—The hides suffer most severely from March to the end of August in each year; they are slightly damaged during the months of February, September, and October; whilst during the other three months of the year they show slight traces, after tanning, by the marks left after the warble holes have closed up. Taking our supply of 50,000 hides (excluding odd numbers) sold during 1888, the amount of damage on the following basis would run thus:—

	£	s.	d.
2*s.* 6*d.* per hide on 9000 hides, being one-third received from March 1st to August 31st	1125	0	0
1*s.* 6*d.* per hide on 2500 hides, being one-fourth received during February, September, and October	187	10	0
9*d.* per hide on 3000 hides, being one-fourth received during November, December, and January	112	10	0
Total	1425	0	0

"Adopting another basis of calculation, taking the average to be 25 per cent. from March 1st to October 31st, and 12½ per cent. for the remaining portion of the year, and taking the damage at an average of 2*s*. 6*d*. per hide, the result would be £1250.

"I am inclined to think that both these estimates considerably under-rate the mischief done, and would especially point out that these figures refer only to the deterioration to the sale of the hides in a green state, and do not take into account the loss to the tanner on the finished article being depreciated in value, or the cost of labour and materials expended in producing leather which when finished is found to be unfit for the purpose intended."—W. H. Hill, Manager to the Sheffield Butchers' Hide and Skin Co., Limited.

"In our market we have a system of inspection for all market hides, being hides of cattle slaughtered in Glasgow and neighbourhood for food purposes only. Under this system the hides are classified,—first and second classes, the latter being faulty flayed and warbled hides.

"Taking the warble months as February to May inclusive, we find the proportion of second class to be 56 per cent., while from June to December the proportion is only about 36 per cent., being, on a fair calculation, an increase of 20 per cent. on account of warbles."—Messrs. Robert Ramsey & Co., Auction Brokers, Hides, &c., Greendyke Street, Glasgow, N.B.

A summary of the above observations and estimates shows warble maggot to be *customarily* present present from February to the beginning or middle of June; and (during the remainder of the year) records are given of the attack as lasting until August; also as continuing until October; also that during the summer and autumn months one-third of the beasts slaughtered (locality named) are warbled; and in another trade report 20 per cent. is named as, on a fair calculation, the amount of warbled hides of cattle slaughtered for food purposes in the period from June to December.

The time of flight of the fly is given by Dr. Brauer as June to September*; this, as the duration of the chrysalis state is from twenty-six to thirty days or a very few days longer if low temperature is unfavourable to development, shows normal continuance of the pest in larval state for many weeks beyond what is conveyed by the word "spring."

Under the present cattle regulations there is probably little danger of spread of infestation from foreign cattle, but just to gtve a single reference as to warble *presence:* in 1887, Mr. Jos. G. Angus (a member of the Newcastle-on-Tyne Hide Inspection Society) wrote me:—"Of the thousands of live cattle brought to the Tyne yearly

* 'Monographie der Œstriden,' von Friedrich Brauer, Wien, p. 127.

from abroad, a very large proportion are badly warbled. There is also great difficulty at times by introduction of warble on Irish cattle into farmsteads, where the greatest care is being exercised to keep the cattle free of infestation." I have once myself had imported American warble sent me. This kind—the *Hypoderma lineata*—has long been known to be in Britain, and the infestation may be found together with that of the maggots of our own kind—the *Hypoderma bovis*—even on the same beasts; but I am not aware of anything that can be considered prevalence of this species.*

From the collective testimony given above, it seems to me to be *proved* that a spring clearing cannot be looked to as a means of "stamping out" warble; but at the same time there is no doubt, that is to say, we hold the proofs in our hand from twelve years' minutely recorded work over a large district, that very great benefit is caused where the spring destruction of the maggots is *properly* carried out.

We have plenty of trustworthy records of benefit from squeezing out or otherwise destroying the maggots, and also of benefit of prevention of attack by use of washes or dressings to keep the fly from egg-laying in summer; but I am not aware of our possessing any other record than that given below of the work being carried on persistently in the spring season of twelve successive years, that is, from 1885 to the spring of 1897 inclusive, and on an area where, taking the table for 1888 as an example, the cattle on the twenty-three steadings under operation, besides the few animals of cottage owners, included three herds of 25 to 27 cows; four herds of 32 to 40 cattle; one of 50, and one of 56; and four others respectively of 57, 72, 79, and 86 animals, chiefly cows, but with a small proportion of heifers and calves.

The work was begun in the year 1885 by Mr. W. Bailey, headmaster of the Aldersey Grammar School, at Bunbury, Tarporley,

* For much that is of interest regarding the warble of North America, see "The Ox Bot in the United States; Habits and Natural History of *Hypoderma lineata*," by C. V. Riley; 'Insect Life' (United States Department of Agriculture), vol. iv. pp. 302–317. From these observations it appears that the American Ox Warble is a distinct species to ours, which is stated in this paper (published in 1892), so far as was then known, not to occur in North America. The American writer considers there is a very important difference in early habits; the larva of their species commencing its progress from the gullet, and thence penetrating through the tissues, until after eight or nine months of this existence it reaches the back, and penetrates the skin, and forms a warble swelling, as is the case with our kind, the *H. bovis*. We have the *H. lineata* in this country, but with my best endeavours I have never been able to get specimens showing the attack in the œsophagus, or the larvæ in transit. For details of differences observable on careful investigation between these two species of flies, and also the differences between their larvæ, the reader is referred to the above paper, which is very fully illustrated.

Cheshire (where the greater part of the pupils are the sons of farmers), showing the boys samples of the warble maggots, telling them the history of the infestation, and begging them to bring what they could find. At that time the warbles were enormously prevalent in the district, and the result was that one pupil alone brought in 250 maggots. The next year's work showed a reduction in the numbers to be found, and the next four years the returns stood as follows:—

1887.	March	28th.—Number of stock examined			293;	warbles found	109.
1888.	,,	20th.	,,	,,	515;	,,	341.
1889.	May	29th.	,,	,,	577;	,,	1077.
1890.	,,	21st.	,,	,,	675;	,,	827.

In 1891 few warbles were found, the largest number brought in by any one boy being 23; and the continuance of the plan year by year reduced the number of the pests to what was practically of little importance, and the work is still continued and reported to me, with information accompanying why there should sometimes be a rise in the number of maggots collected, which was the case in the spring of 1897, consequently on some of the boys being enabled to go beyond the district under previous care.

This work was done with full approbation of the farmers, and was considered so satisfactory that an account of what was being carried on, written by Mr. Bailey to His Grace the Duke of Westminster as one of the great landowners of the district, was read by the Hon. Cecil Parker, in 1887, before one of the Committees of the Royal Agricultural Society, and was recommended for publication.

The above notes show the great success of the continued attention to removal of the maggots, but also that with every circumstance in favour of this success, still the pest was not stamped out.

The work was done by the boys who were accustomed to be with cattle, and more or less well known personally to the herds amongst which they searched out the warbles, which is an important matter. Also there was a great incentive in a mark being given for each maggot, which counted for something towards a few prizes which were yearly given to the most successful collectors.

But the specially important point which was met in this treatment was that the search went on *constantly* up to a certain date. The warble maggot matures very rapidly towards the completion of its growth, and whilst on the one hand (under the system of compulsory inspection) the presence of warbles may be made a cause of great annoyance to an owner whose beasts have been cleared only a few days before, on the other, an unskilled "policeman" will probably overlook many which would shortly be what is called "ripe."

The time requisite for inspection would be something enormous,

and also, though in the following point a veterinary opinion would be needed if the difficulty I believe would occur, *does* exist, I should conjecture that the frequent annoyance to the cows caused by presence of complete strangers disturbing the quiet of the herds and frightening the individual animals by handling and turning up the hair in the search for neglected warbles would be likely to be seriously prejudicial to their health, even if the "policeman" was accompanied by the herdsman. If he has free access without, the results might cause much greater loss from terrification of the breeding stock than any moderate amount of warbles; and, as I have been so repeatedly written to in the past few months to request me to give my views on compulsory prevention, I trust, in laying the above points before my readers, that I am not intruding beyond what I may with all due deference submit to them, more especially because, as previously mentioned, I believe that the Board of Agriculture has been referred to, and replied that it was considered undesirable to move in the matter.

It lies in the cattle-owners' hands to clear their beasts so as to make an enormous reduction in the amount of warbles; the simple methods by which this can be done have long been before the public, but there is a great need that this information should be more disseminated; and it is eminently to be wished that more care should be taken as to *the authority* on which recipes and directions for dressings are brought forward.

There is advice abroad—as, for instance, that of a general smear of the hide to kill the maggots in the warbles—which is *worse* than useless, for, while it does no good in itself (as to kill the maggot the application must be thoroughly placed so as to choke the breathing-pores or poison the grub in each warble), it stands in the way of proper applications. Also there is advice good in itself, but that would be much more serviceable if the name of a well-known adviser was appended.

At p. 747 of the fourth part of the Journal of the Royal Agricultural Society of England for 1897 is an excellent recipe for a smear for prevention of attack of the Warble Fly, with the remark prefixed,—"In the Proceedings of the Council of July 31st, 1895, the Society gave the following directions for the prevention of warble attack." But to many of us it would have strengthened the advice if the recipe had been acknowledged to its original contributor, the well-known veterinary surgeon Mr. Henry Thompson, M.R.C.V.S., Aspatria, Cumberland, by whose permission I printed it as follows in my Annual Report for 1884, with his name appended, and we have thus (from my contributors) knowledge of success of the treatment on thirteen to fourteen years' evidence:—

"I have used and also recommend the following mixtures as a preventive:—Flour of sulphur, 4 oz.; spirits of tar, 1 gill; train (whale) oil, 1 quart. Mix well together, and apply along the spine of the cow once a week with a small brush. The smell drives off the flies, and prevents them depositing their eggs, and the cattle are left *at peace* to graze, and warbles thus prevented."—HENRY THOMPSON, Aspatria.

In the whole course of my reports of warble prevention I have named the authorities to whom I was indebted, and thus they give (*verbatim*), to save danger of mis-statement, the views of known writers,—on the more especially veterinary points, for instance, as of Dr. George Fleming, C.B., Prof. Penberthy, President of the Royal Veterinary College, Mr. Henry Thompson, M.R.C.V.S., &c.; on treatment, the contributions will be found there of Mr. Stratton, Mr. Duckham, Mr. Farrell (on success of treatment of two hundred and fifty of his herd of eight hundred head of cattle), and of others, in scores or rather perhaps in hundreds of many of whom the names are well-known to all conversant with cattle treatment.

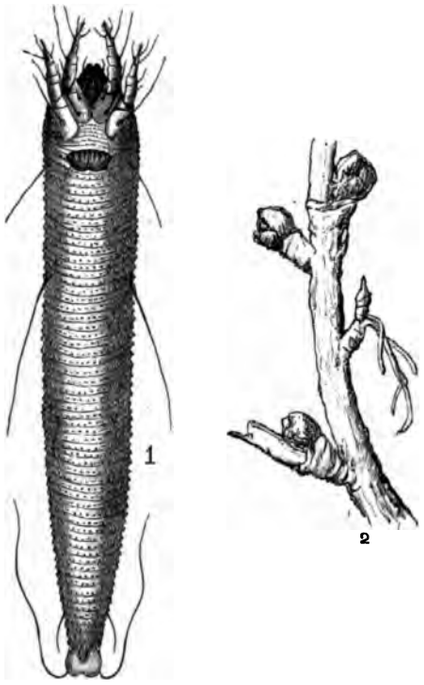
I take no credit to myself for the work beyond careful presentation of the views intrusted to me for the public use; but I certainly think that it is right to note for the benefit of those concerned that those records of almost every imaginable detail of life-history and preventive measures against this pest *do exist and are procurable.*

And in regard to distribution, I should be only happy to distribute the remainder of my 62-page abstract of information gratuitously to all applicants so long as I still have copies, and also to continue distribution of my leaflet—which has now reached the hundred and fifty-first thousand—gratuitously in any numbers desired.

APPENDIX.

BLACK CURRANT.

Currant Gall Mite. *Phytoptus ribis*, Nalepa.



PHYTOPTUS RIBIS, greatly magnified; natural length of female 0·23 mm. (by permission, after Dr. A. Nalepa). Black Currant twig with Mite Galls.

For many years the Currant Gall Mite infestation to Black Currants has been a trouble to Black Currant growers, but its steadily increasing prevalence and the failure of the remedial measures which have been hitherto tried to do more than lessen the evil are making the matter one for very serious consideration.

The mischief is caused by an exceedingly minute Mite, too small to be seen by the naked eye,—scientifically the *Phytoptus ribis*,—which lives and propagates in the buds, and causes an unnaturally large

development of these into spherical or somewhat oval soft green knobs, formed outside of greenish scales or abortive leaves folding over each other, and inside of the various parts which would gradually have developed into leaves, flowers, and fruit, in contorted and unnatural condition, and abortive for any useful purpose.

These "knobs" may be found forming during the winter whilst the healthy buds are still of their natural shape, and in January may be found up to as much as a quarter of an inch in diameter, and containing within them numbers of the Mites and some eggs. Later on, growth of the gall knobs continues until they may at times be found as large as some specimens sent me from Toddington during the past season, which proved to be for the most part from about three to four-eighths of an inch in diameter, and, in the case of the upper specimens, were dying and drying off into the condition in which the Mites leave them and emigrate to set up attack in the still embryo buds in the axils of the leaves.

Much consideration has been given to the subject by various of our leading experts on Currant growing, and various experiments are being set on foot, and especially on the Experimental Fruit Farm of the Duke of Bedford near Woburn, Bedfordshire, which it is hoped may throw some light on how to mitigate the great and the increasing loss. But the history of the infestation not being as fully before the public as seems desirable, I have endeavoured in the following pages to give some information on,—firstly, the records we have of the first observation of the pest in this country; secondly, its life-history; thirdly, observations of presence in different parts of the country, together with notes of various kinds of treatment which, even where temporarily successful, have not answered permanently in getting rid of the attack; and fourthly, considerations as to improved methods of growing, and also notes of experimental treatment which it is proposed to carry out under careful supervision at the Duke of Bedford's Fruit Farm, Ridgmont, Aspley Guise, Bedfordshire, and which I am kindly favoured by permission to insert.

First observations of the Black Currant Bud Gall infestation in this country.—The first definite allusion to the presence of this Black Currant bud disease being observed in England took place (so far as I am aware) at the meeting of the Scientific Committee of the Royal Horticultural Society on March 2nd, 1869. Prof. M. J. Berkeley then called attention to some buds of the Black Currant, sent from Bedale, Yorkshire, which were curiously deformed (similarly, it is noted, to some specimens previously described by Prof. Berkeley in the 'Gardeners' Chronicle' for 1864, p. 363). Prof. Westwood, on examining the buds, gave it as his opinion that the growth in question was due to the attack of a peculiar species of *Acarus* differing considerably

from other species in its tapering form, and in it having four legs instead of six.*

A few days later on Prof. Berkeley reported that he had since the above notice was written received an abundant supply of fresh specimens in such a state as to enable him to study the matter satisfactorily. He observed that he had no difficulty in finding the little *Acari*, though they were exceedingly minute, for they were in such abundance as to present the appearance of a thin coating of white powder; and the little worm-like creatures, when examined under a high magnifying power, were found to be accompanied by eggs. The smallest specimens of the *Acari* were noted as about 1-250th of an inch in length, whilst the largest scarcely exceeded 1-140th. The abdomen was closely striated with granular lines, and furnished with two setæ at the extremity, and one on each side; the legs were four in number, and there were a pair of palpi. The eggs were mostly obovate or broadly elliptic, and about 1-500th of an inch in diameter.

The disease was stated to have been first observed by Prof. Berkeley's correspondent in Yorkshire about four years previously, and to have increased rapidly, "and seems likely to make the cultivation of the Black Currant very precarious." †

At p. 841 of the volume of the 'Gardeners' Chronicle' referred to below are some more detailed observations of the characteristics of the Mite, which is noted as white, fleshy, and covered with minute points closely arranged in very numerous transverse rows, forming striæ of granular lines, and the body is terminated on either side by a long bristle. The general form long, convex, and tapering to the extremity of the body, with the anterior portion of the body more conical, the dimensions averaging 1-200th of an inch in length, and 1-500th of an inch in width. A figure given accompanying is so far of value that it shows the transverse striæ, and the legs being four in number, otherwise it is not a satisfactory delineation.

The circumstance is mentioned by Prof. Westwood of a correspondent sending specimens of infested Currant buds from Blantyre, N.B., in the beginning of July, stating that the disease was quite general in that district, and had been known for twenty years, and that after a plant is infested very little fruit is to be obtained from it, and that the writer had examined the buds even during the period of frost and snow, and had then observed the young animals hatching from their eggs.‡ The study of this branch of the *Acarina* being then in its infancy, there was much speculation as to the precise nature of the

* See report in 'Gardeners' Chronicle' for 1869, p. 252.

† 'Gardeners' Chronicle' for 1869, p. 276.

‡ 'Gardeners' Chronicle,' *loc. cit.*

infestation, but the above observations, given as definite statements, agree with what subsequent investigation has proved to be correct. We thus carry back knowledge of presence of the disease to 1869, and report of its presence by an observer well acquainted with it to twenty years before, namely, to 1849.

Life-history.—The family of the *Phytoptidæ*—to the genus *Phytoptus* of which the *P. ribis*, or Currant Bud Mite—belongs, is one of the divisions of the order *Acarina*, or Mites, but is distinguishable from all the other families by its more or less elongate, cylindrical, or worm-like shape, and also by only possessing four legs throughout its whole life.

The Mites of the other families of the *Acarina*—as, for instance, the Red Spider of the Hop, the *Tetranychus telarius;* the Hay Mite, *Tyroglyphus longior;* the Beetle Mite, *Oribata lapidaria*—are of a much rounder or more oval shape, but are especially distinguishable by their greater number of legs. As a rule, they possess three pairs when they are hatched and in their earliest stages, but, with subsequent moults, as they approach maturity they become possessed of four pairs.

This point of the number of legs is a very important one to observe, in order to prevent confusion in identification with other kinds of Mites which may very likely be found on Currant bushes.

The *Phytoptus ribis* is of the shape figured at p. 141, that is, long, narrow, cylindrical, somewhat tapering towards the blunt tail, at the extremity of which, on each side, is one long bristle, and there are also two other pairs of bristles one on each side of the body—one pair near the fore part, the other a little before the middle. The proboscis is short; the four legs are plainly jointed, and the abdomen with about seventy punctate transverse rings. The length of the female is 0·23 millimètre, the breadth 0·04 millimètre; the dimensions of the male are smaller.*

The infestation is to be found on the Black Currant (*Ribes nigrum*) both in Great Britain and on the Continent of Europe. Likewise occasionally on the Red Currant (*Ribes rubrum*) and the "Tasteless Mountain Currant" (*Ribes alpinum*). In regard to the infestation on the Red Currant, the only specimens I have seen were some received by me on January 15th, 1888, by favour of Dr. Friedrich Thomas, of Ohrdruf, Gotha, well known for his researches in phyto-pathology, with information accompanying that he had observed them for many years in his own garden, but that up to date of writing no notice of the attack had been practically taken in Germany.

* For practical purposes it is enough to mention that the Mites are so excessively small as to be indistinguishable to the naked eye. A millimètre is the 25th part of an inch, and twenty-three hundredths of this measurement—that is, somewhat less than a quarter—is scarcely perceptible except when magnified.

In regard to the *Ribes alpinum* we have no record, so far as I am aware, of the *Phytoptus* infestation having been found on this species in this country; but as the plant does occur with us, it might be worth while to make some investigation. In 'English Botany' * this species is stated to be found "in woods. Truly indigenous in the lower part of the western dales in Yorkshire, and said also to be wild in the counties of Warwick, Stafford?, Nottingham, Glamorgan, Durham, and the Lake District. It also occurs in several of the Scotch counties, but has little claim to be considered native in them." One very noticeable distinction between this and the other two kinds named is that the racemes (the bunches of fruit in popular parlance) are *upright* in the case of *R. alpinum*, whilst in the case of *R. nigrum* they are drooping, and usually, although not always, they are drooping in the case of *R. rubrum*.

The following notes give the life-history of the *Phytoptus ribis* as recorded by Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, from his personal observations during the year 1893, and are of much interest for practical use as giving a fairly continuous account of the condition of this destructive Currant bud attack from the beginning of the year until the middle of September. Mr. Newstead remarks:—

"During the cold month of January the Mites in the infested buds were all in the perfect condition, and although the temperature was often very low, the Mites revelled in the severest frost. . . . Frost seems to have no effect on them whatever, except to make them somewhat sluggish.

"On February 20th egg-laying commenced, and on this date I found them in hundreds in company with the adult Mites. Later (March 6th), there were thousands of young forms (nymphs), eggs, and adults.

"On April 19th many of the old and very badly infested buds of last year had opened out very considerably, but had not produced, nor did they afterwards produce, a single leaf. These and the rest of the infested buds contained a living mass of the Mites in all stages, completely covering every embryo leaf in the buds. At this date numbers of the old infested buds had already become black and dried up, due in part to the fact that the buds had been transplanted in the spring, and to the excessively dry weather. All the old buds that were examined had no living Mites in them, but the dead white desiccated bodies of thousands of Mites covered the surface of the dead leaves of the buds.

* 'English Botany,' edited by Prof. Boswell Syme, vol. iv. (3rd edition), p. 41.

"May 19th, examined fifty of the old infested buds which were sent me by Mr. Gillanders from High Legh, which were taken from bushes that had not been transplanted in spring. Ninety per cent. of these buds were dead and dry—a few only having their basal portions with any life in them. In these there were many dead Mites, which had undoubtedly died a few hours previous to my receiving them, as they still contained their colour and outline intact. Those buds that were quite dead and dry gave the same results as previously stated,—*e.g.* they were covered with the desiccated bodies of the Mites, and not a living example was found amongst them. Strange to say, I failed to find a single living Mite either on the bark at the base of the leaf-stalks or in the newly-formed buds.

"My next examination was on June 2nd. At this time the newly-formed shoots had begun to harden, and the new buds on the first half of them had attained a length of 2½-3 mm., very small, but just protruding behind the leaf-stalk. Between the base of the leaf-stalk and the buds, at the ends of the young shoots, I found both adults and nymphs, but no eggs; although these latter were not found in the situations indicated, they must have been laid there, or the nymphs would not have been present.

"I carefully examined a number of young buds, but found no Mites in them. It is curious to note that the Mites occurred near the terminal buds only; this will account for such *buds* on an infested bush being most severely attacked. At this date (June 2nd) I could only find one of the old infested buds in a living condition, and this simply swarmed with adult Mites.

"On July 17th I again found the Mites located between the leaf-stalks and the buds, and with them many eggs; while ten days later (July 27th) newly-formed buds, still small, were present, but terminal ones were already showing signs of being infested. On examination these were found to contain adults, nymphs, and eggs, nearly all of which were located in the centre of the buds. This was the first occasion I found the Mites within the newly-formed buds. The old infested buds at this date were everyone of them dried up.

"During the month of August I was unfortunately away from home, and was not able to resume my investigations until Sept. 13th. At this date the new buds showed decided signs of being infested; they were much swollen, and measured 2½ to 3 lines in length, and contained the pest in all its stages. I could not, however, find any of the Mites behind the leaf-stalks as previously, so that I concluded they had taken up their winter quarters for good, and had set to work in earnest to ruin the crop of fruit while yet in the bud."

To the above observations Mr. Newstead appends the following summary. (2) is omitted as not of practical bearing:—

"(1). There were a succession of broods produced during the months of February to September. Egg-laying taking place in March, April, June, July, and September, which was therefore very probably carried on throughout the whole season.

"(3). That the Mites first established themselves between the base of the leaf-stalk and the young buds early in June (June 2nd), but were not found actually inside them until July 27th.

"(4). That so long as any life remained in the old buds swarms of the Mites were found in them; as the buds died numbers of the Mites disappeared, either dying a natural death, or being destroyed by predaceous insects. Of course, as I have already stated, some of them did certainly migrate and set up fresh colonies."—(R. N.) *

It is a pity that this useful little pamphlet is not more generally known of, as the information contained in it as to the dates of egg-laying, migration, and other particulars are precisely what are needed for a basis of attempts at least towards serviceable preventive measures.

During the present month,—that is to say, January of 1898,—as it occurred to me that in this more southerly locality than Cheshire, where Mr. Newstead's observations were made, and also, in the circumstances of the unusually mild weather of the winter up to date, it would be of interest to find whether the egg of the *Phytoptus* was present within the galls, as well as the Mites themselves, and on opening various Black Currant galls on January 25th and 28th, which I was favoured with, at my request, from the Woburn Fruit Farm, Ridgmont, Bedfordshire, I found a few eggs present.

These were oval or ovate when in characteristic condition, but sometimes irregular in outline, apparently from being pushed out of shape by the developing Mite within; but I was not fortunate enough to find a specimen in the very act of developing, as I have seen in the case of the *Phytoptus* of the Birch knots.

From my own Currant plants being clean, I have not had the opportunity of watching progress of the infestation myself; but on one occasion in specimens sent me on the 4th of April from Hanbury, near Droitwich, I found the minute white eggs in various stages of development; some still round or roundish, and others pushed out of shape at one end by the pressure on the thin egg pellicle of the bluntly-pointed head of the Mite within, the locality of the legs of the Mite being also indicated by little knobs, showing the position within of what might be called the shoulders.

* "Recent Investigations of the Currant Bud Mite (*Phytoptus ribis*)," by R. Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, Lecturer on Economic Entomology for the Cheshire County Council, pp. 5–7. Reprinted from 'The British Naturalist' for June, 1894. Price 3d.

In the case of the specimens from Woburn, I was particularly struck with the large size of the egg in comparison with the Mite, and turning to the observations of Dr. A. Nalepa on this subject, I find that he notices that "the eggs" [of the Gall Mites] "are relatively to the minuteness of the creatures of considerable size. . . . The egg-shell is thin, flexible, and formed of chitin." The author also remarks:—"In the latter part of summer and in autumn the Mites leave the galls in multitudes to take possession of their winter quarters—that is, the buds. This emigration also is of frequent occurrence during summer when the previously inhabited buds dry up."*

The preceding notes give, I think, a fairly complete summary of the history and also of the life-history of this infestation up to the present date. The following observations refer to various methods of treatment by which it has been endeavoured to check the mischief caused by this attack, some of which have appeared to be beneficial for a time; but none of which, so far as I am aware, have proved permanently reliable.

The first notes that were sent me of injury from Currant Mite were forwarded in the year 1885, when on March 25th the bud galls were already causing much injury on the specimens sent me; and later on specimens were sent me from the neighbourhood of Cottenham, Cambridgeshire, by Mr. Arthur Bull, with the information that about half an acre was affected, and that he was using "a dressing of two parts sulphur and three parts lime boiled together in water (2 lb. sulphur and 3 lb. lime, 3 gallons of water), which is further diluted at the rate of two or three pints to a large pail of water, applied with a syringe to the infested bushes." The effect of this application was that little or no damage was done, but the remark was made that "it seems difficult to clear the garden altogether."

In 1887 the infestation was reported as seriously troublesome in various localities, amongst these Clydesdale being especially mentioned; and on March 15th Mr. W. James le Tall wrote me regarding it from Hackenthorpe, West Sheffield, mentioning that "If the disease once gets into a plantation of Black Currants, it passes from tree to tree till all are infested, and from being a fruitful plantation it becomes in three or four years almost fruitless. No cure is known for the disease here but destroying the infested trees. This disease I have

* 'Die Naturgeschichte der Gallmilben,' von Prof. Dr. Alfred Nalepa, pp. 15, 18. (Erganzter Sonderabdruck aus dem ix Jahrsberichte des K.K. Staats-Gymnasium in Wien iv Bezirk). For technical description of *Phytoptus ribis*, Nalepa, species of *Ribes* (Currant) infested by it, and also figures, the reader is referred to 'Beiträge zur Kenntniss der Gattungen *Phytoptus*,' by the same author. (Besonders abgedruckt aus dem lxii Bande der Denk, Mat-Naturwissenschaftlichen Classe der K. Acad. der Wissenchaften, Wien, 1895).

noticed about fifteen years, but now it is very much more prevalent, and threatens to destroy the Black Currant crop in this vicinity." Severe complaints were made from elsewhere in England and Scotland, but no remedial measures were known of.

The following year gave the same results; bad mischief, but no known means of remedy, with the information from Ohrdruf (see p. 144) that Red Currants were not exempt from the infestation; and in 1889 still no advance was made in checking the attack.

In 1891, Mr. C. D. Wise, Manager of the Toddington Fruit-grounds, Winchcombe, Gloucestershire, sent me the first observation of endeavouring to lessen amount of infestation by clearing the galled bud growths, which were in such quantities that he wrote on the 16th of April he was sorry to say the women had to pick basketfuls.

In 1892, as well as in the preceding year, I had some remarks regarding co-tenants in the galls, of various larvæ; but as it does not seem feasible to utilize the services of those which are or may be destructive to the *Phytopti*, it does not seem worth while to do more here than refer to the circumstance being entered on. But in the same year Mr. John Biggs, of Laxton, Howden, East Yorkshire, mentioned, on April 10th, some degree of success from the following treatment:—

"You will, I am sure, be interested in knowing that I have to a certain extent prevented the *Phytoptus* utterly ruining my Black Currant trees. As you suggested in a letter of last March, we syringed the bushes twice with the solution of Paris-green, which I procured from Messrs. Blundell, and gave the soil all under the bushes a good coating of caustic lime. I also gave the bushes another dressing of the Paris-green. Just when the buds appeared this spring, I had a boy gathering all the little knobs of the trees. The result has proved as satisfactory as I could expect, considering the condition of the trees last year, and I have every prospect of securing a good half crop. Our neighbours' trees in this village are utterly ruined, scarcely a leaf to be seen this year, and the trees completely covered with the infested knobs."

In this year Mr. C. D. Wise, of Toddington, wrote further with regard to effect of removal of the bud galls (mentioned above) that "they had certainly decreased the trouble by picking off the buds."

In 1893, Mr. John Speir, Newton Farm, Newton, near Glasgow, made some report of experiment begun on a few bushes in 1891, which consisted in cutting back the stems of the bushes which were very badly attacked to within two or three inches of the ground (the branches being carefully gathered and burnt). A mixture of soft-soap dissolved in hot water to which paraffin oil was added, and stirred so as to make it combine, was diluted to a safe strength with cold water,

and syringed on to the stumps of the old bushes, and on the ground about, and on the neighbouring bushes. The bushes pushed up new shoots, and at the date of Sept. 29th, 1893, Mr. Speir reported that during the spring no affected buds were noticed, either on the bushes that were cut back, or on the others surrounding them, and during the year the bushes appeared in a very favourable way of making good growth and healthy wood in the future.

In 1894 Mr. Speir reported that "the Currant bushes treated for Mite in 1891 and 1893 still keep quite free"; but the improvement, however, did not last thoroughly, for in 1897, on February 27th, Mr. Speir wrote me as follows:—"I regret to notice to-day that some bushes which I severely pruned and dressed with paraffin emulsion some years ago for the Currant Mite are again showing symptoms of the disease. Both last spring and the one before I think I wrote you stating that the treatment up to these dates seemed effective; such, however, appears now not to be the case. I am therefore inclined in future to advise no one to attempt a cure, but to pull up all infested bushes at the *first symptoms*, and also the nearest apparently healthy bush to those visibly affected."

On April 7th, in the past season, Mr. C. D. Wise (Manager of the Toddington Fruit-grounds, Winchcombe, Gloucestershire) favoured me with the following report in continuation of his previous observations on the subject of clearing infested bud galls, which, I think, completes observation of all the plans hitherto tried as remedial measures being more than palliatives of this destructive infestation.

In the following notes it will be seen we have details of the number of quarts of galled buds gathered in the years 1896 and 1897, with cost of gathering per acre; and also the absence of benefit from the outlay (see note dated December 22nd, 1897). Likewise Mr. Wise reports that no benefit was found to result from cutting the Currant bushes down to the ground, with treatment specified:—

"*Gall Mites on Black Currants.*—We have a very serious attack of Gall Mites this spring, as will be shown by the following statement:—

Field Number.		Quantity of Galled Buds picked per acre.	Cost of Picking.
1	1896	... 1½ quarts	8s. 6d. per acre
	1897	... 12 ,, ...	7s. 6d. ,,
2	1896	... 2½ ,, ...	4s. 6d. ,,
	1897	... 8 ,, ...	6s. 9d. ,,
3	1896	... 4 ,, ...	5s. 6d. ,,
	1897	... 16 ,, ...	10s. 10d. ,,

"Where we have picked the Gall Mites off last autumn, the attack seems to be quite as bad this spring. You will see that the cost per

acre picking off the galls comes to a very serious item, but I do not see that there is anything else we can do; if you can suggest anything we shall be very glad.

"We have in some cases cut off the trees to the ground, and the young trees when they come up are full of Gall Mites. We have syringed with Paris-green, and we have limed the stools; all this seems to have no effect in getting rid of them.

"What we want to know is more of the life-history of this pest; where does it hybernate, and what season of the year does it move from bud to bud, and when is the breeding season?"

On December 22nd, 1897, Mr. Wise wrote further:—

"*Acari.*—I am sorry to say that the Black Currant Gall Mite increases with us; the bushes this autumn are covered with galls, and it is becoming really a most serious matter to know what to do. If we could only find out a little more of the life-history of these Mites, we might be able to cope with the pest."

In the course of correspondence and of observations of this attack, it occurred to me that it might be possible that there were varieties of the *Ribes nigrum* which were less liable to attack than others, and consequently on my application on this subject to Prof. J. Jablonowski, Director of the Government Entomological Station at Budapest, Hungary, he was good enough to procure for me from the Director of the Horticultural Institute some cuttings of Black Currant, which arrived in excellent condition, and which I shared for experiment between Mr. Speir (above mentioned) and Mr. Wise, keeping two or three for myself, but which afterwards, on having the pleasure of becoming in communication with Woburn, I forwarded for trial. We shall thus learn whether my view of there being possibly "Mite-proof" varieties is well founded, though I fear it may probably be otherwise.

The following valuable notes were sent to me in reply to some of my enquiries on this subject, as well as of other possible means of lessening amount of the Black Currant *Phytoptus* injury, by Mr. Malcolm Dunn, from The Gardens, Dalkeith; and I feel much pleasure in giving his well-weighed views on the points that I submitted to him:—

. . . . "I will answer your queries about the 'Black Currant Bud Mite' in the order they come in your letter.

"1. *The kinds of Currants most liable to attack.* — So far as I have seen, or heard, the attack of the *Phytoptus* in question is confined to the one 'kind' of Currant (*Ribes nigrum*, L.) in Britain; and so far as my personal observations go, I have not noticed the insect showing a preference for any one or more of the 'varieties' of the Black Currant. It is one of the few cultivated fruits which diverges very little in its character.

"Taking the best-known variety—'Black Naples'—as the type, all the other *so-called* 'varieties' (of which Hogg describes *five* in his 'Fruit Manual,' and I grow here at the present time *over a dozen*!) are so little different in any specific and permanent character, that it is very difficult to distinguish any difference after they have been growing alongside of each other and all receiving the same treatment for a few years. Whether reputed 'seedlings' or acknowledged 'selections,' it all ends in the same thing; they are liable to revert to the type, and if the best of the garden varieties stray to hovels or waste places, they soon deteriorate into the 'Common Black Currant'—an inferior variety, but *not* proof, even in a wild state, against the attacks of the *Phytoptus*. The most vigorous variety grown (called here 'Black Prince') is quite as liable to attack as the weakest—which here is the 'Common Black.' I have grown numerous *seedling plants* of the Black Currant; but generally they are little better, in vigour and fruiting qualities, than the common variety.

"The conclusion I draw from my experience of the attacks of the *Phytoptus* on the Black Currant is, that the *mite being present*, no variety is proof against attack. The severity of the attack may vary under different conditions, and it is not at all impossible but a variety may be found which the mite will not attack; but it is not yet in cultivation, and the chances are small of its appearance. If it is not a *first-rate* variety from a gardener's point of view, it is of little consequence whether it is mite-proof or not!—and it must be *mite-proof*, or we may derive very little benefit from it.

"The variety you have got under the name of 'Bang-up' is an old variety of Black Currant, and not equal to several good strains now in cultivation. I rather think it is still grown in Clydesdale gardens, and there of course *every variety* of Black Currant *is infested by the Mite*.

"(2.) *Grafting or budding on Red Currant Stocks.* — The Black Currant does not 'take' well on the Red; but it can be done for a test; the success of which, however, is doubtful if the Mite is in the neighbourhood, and thriving!

"(3.) *Would Standards be more free from the Mites?* — Under the usual conditions, I am afraid they would not. I will explain the reason later on.

"(4.) *Syringing, or Spraying the bushes with a liquid insecticide as a remedy.*—When done *thoroughly*, and at the *right time*, it is the best check against the spread of the Mite that we possess; but when large quantities in private or market gardens are infested with Mites, a dozen of which can safely hide in a very small cranny of overhanging bark, and remain perfectly secure from any sprayed insecticide, the chances of extirpating them are not great!

"Dusting with a powder insecticide is less efficacious, because it

does not find its way into so many of the crevices of the bark as a *hard driven spray* will do. The whole difficulty lies in the habits of the Mites securing shelter to them from all practicable remedy *outwardly applied.*

"*Steady and continuous spraying daily*, while the Mites are on the move from the old buds to new ones in the early summer, would go a long way to free badly-infested bushes from Mites; but it would require yearly attention, and I am doubtful, with an easily grown crop like Black Currants, if it is *worth the cost.* In these days of *highly paid manual labour* we have to look very closely at the *cost* of an operation of this kind, and *feel sure* it is *worth it* before we employ it on an extended scale.

"The Black Currant is so easily grown from CLEAN *cuttings* in the course of three or four years to good-sized bushes, and bearing freely, that the cleaning of old bushes at a considerable cost is not, I think, judicious. Much better to clear off the bushes root and branch, and burn every morsel of them on the spot. Grow other crops on the land till all *Black Currant Mites* are starved out, and the *remedy is complete.*

"(5.) *Mixed cropping, or alternate rows of Black Currants and Gooseberries.*—An excellent method of growing Black Currants, whether the intermediate crop is Gooseberries, Strawberries, or vegetables, because it allows more freedom in dealing with each row of Black Currants, and if they should become infested with Mites, there would be more room to reach them than when crowded into rows four to six feet apart, in the usual way, where men can hardly push their way through between them.

"I have reason to believe that the usual method of *close rows*, in *large breaks* or quarters of Black Currants, has a good deal to do with the bad attack of Mites so often seen on massed bushes; while single rows, with free space of some feet or yards between them are less infested in the same district. The close rows naturally afford better *shelter* and more *breeding ground* than detached rows, and hence the partial immunity of the latter.

"Still, after all, if Mites are present in a garden, you are never safe to allow them to remain, and think they will *not* spread! Let a favourable season for the Mite come round, and their advance will astonish you! It is then too late to apply a remedy that will be worth the cost. The *proper time* is the *first sign* observed of the presence of the Mite. *Attack it then*, and it may *quickly be exterminated.* Let it run its course for a season or two, and attempts to clear it off (short of burning every infested bush) are more likely to end in failure than success.

"There is little doubt the workers rubbing on the infested bushes with their clothes, when the Mites are *lively*, carry them to clean

bushes and spread the infestation. *Birds, wind,* and *infested prunings* do the same thing! No wonder then that the pest spreads rapidly when once it gets a foothold in a break of Black Currants.

"The best protectives are *clean ground; clean* and *vigorous* young bushes, *wide apart; high cultivation;* and a *watchful eye* on the *first sign* of a *Mite,* and its IMMEDIATE DESTRUCTION!"

From comparison of the various observations of careful work under the superintendence of well-known managers or owners of large breadths of Black Currant ground, it seems clearly shown that at present none of the preventive measures tried can be trusted to as permanently serviceable (and even the removal of the galled buds which must necessarily destroy a part of the infestation) by no means acts satisfactorily.

But there is one point in method of growing which is alluded to above in the replies to my enquiries with which I was favoured by Mr. Malcolm Dunn, and which I believe would be of great practical importance both in lessening spread of infestation, and in laying open what *is* present, much more to observation, and consequent remedial measures (to be applied *at once* on observation) than is at present the case.

This is, the growing of Currants in lines, or long plots, with other crops between, instead of, as is often the case at present, growing the bushes together year after year on the same ground, and even up to areas of several acres. In this present way, besides the spread of Mites from bush to bush in their migrations, which it is impossible to guard against, there is in all probability a great spread of Mites by carriage on the clothes of "pickers," or other workers who have to move amongst the bushes (and in the first case at least) cannot avoid their hands and sleeves coming much in contact with the stems during the removal of the fruit. As we all know there are some practical difficulties in the way of intermediate lines of crop by reason of the long distance to which the roots of the Black Currants spread from the bushes; still in the very great difficulties in which we stand at present, I believe that the intermediate cropping is well worth consideration, and that until the elaborate and careful experiments mentioned below, which are being instituted at the Experimental Fruit Farm at Woburn, afford us better preventive guidance than we have at present, that it is to separation of the great masses of infested bushes that we must look, to give us opportunity of in some degree preventing the spread of the infestation.*

* The following note with which I was favoured on January 20th by Mr. Lewis Castle, Manager of the Woburn Experimental Fruit Farm, from Ridgmont, Aspley Guise, Bedfordshire, gives some very serviceable observation on the above point:—

"Upon reflection, I think your suggestion with regard to planting Black

By kind permission of Mr. Spencer Pickering, F.R.S., Director of the Woburn Experimental Fruit Farm, I am permitted to insert the following account of the experiments now in progress, and also the proposed course of treatment arranged after much consideration of the requirements of the case.

The following note, with which I was favoured by Mr. Pickering on January 29th of the present year, gives a short general preliminary statement of work in progress or under contemplation :—

"The scheme of investigation which I have adopted with the Black Currants is as follows :—

"Two separate plantations are each apportioned to experiments with paraffin, calcium sulphide, antinonnin, and carbolic acid. In each case there are plots in which the insecticide is used in four or five different strengths. The dressings will be applied once a month. After the buds begin to expand, the plots will be subdivided, and in one section of them the dressing used previously will be continued, and in the others weaker dressings of various strengths will be applied. There are also various other experiments.

"I propose at intervals of time to have the buds examined to see whether the Mite is still vigorous. This need be done, in the first instance, only with those where the strongest doses have been used." —(S. P.)

The following notes forwarded to me on January 14th of the present year give particulars of what has already been done at Woburn in regard to the Currant Mite ; and also give information as to the varieties of Black Currant under observation, time of planting, date of appearance of infestation, and treatment of various kinds :—

WOBURN EXPERIMENTAL FRUIT FARM.

Black Currant Bud Mite.

"VARIETIES GROWN.—Baldwin's Black, Black Naples, Lee's Prolific, Carter's Champion, Agden's Black, Old Black.

"TIME OF PLANTING.—The majority were planted in trenched ground in the autumn of 1895 and the spring of 1896, but a few were planted in the autumn of 1894.

Currants in lines between other crops is important, and likely to prove beneficial where the plantation was gradually formed, and the bushes may be obtained from various sources. The fact that ours are all planted in such lines may have been partially the means of preventing the more general extension of the 'Mite,' which is at present mainly confined to the one plot of Baldwins, though instances are observable in other plots, but scattered. Certainly it should be practised wherever it can be done conveniently, as bushes and trees of all kinds in single lines alternating with others ripen both wood and fruit better than when crowded into dense plantations."—(L. C.)

"APPEARANCE OF INFESTED BUDS.—1895: A few buds were observed, but no general attack, and these were at once removed and burnt.

"1896: This year the buds were much more numerous, particularly on Baldwins; but they were again carefully removed and burnt.

"1897: Baldwins were found to be seriously affected before the fruit was all gathered in July and August. The removal of the buds would have been a tedious and expensive process, and seemed to be ineffectual; the following methods were therefore adopted with the Baldwins.

"*While the foliage was on the bushes.* — The whole of the bushes were watered or syringed with diluted calcium sulphide of different strengths. No effect was observed.

"*After the foliage had fallen.* — 1st. Plants cut down close to the soil. The stumps to be dressed with an insecticide, and the roots to be heavily manured. Every piece of growth bearing buds was removed. Subsequently some of the stumps were cut down to the roots.

"2nd. Plants dug up, and the whole of the stems dipped twice in the following solutions before replanting:—

A = carbolic acid, 1 pint to 16 gallons water (proportion 1 : 128).

B = carbolic acid, 2 pints to 16 gallons water (proportion 1 : 64).

C = carbolic acid, 3 pints to 16 gallons water (proportion 1 : 43).

D = calcium sulphide solution, 1 quart to 16 gallons water (proportion 1 : 64).

E = calcium sulphide solution, 2 quarts to 16 gallons water (proportion 1 : 32).

F = calcium sulphide solution, 3 quarts to 16 gallons water (proportion 1 : 21).

"3rd. Plants not lifted or cut. Watered three times with the following from a rose-can:—

A = carbolic acid, 3 pints to 9 gallons water (proportion 1 : 24)

B = calcium sulphide, 3 quarts to 9 gallons water (proportion 1 : 12).

C = petroleum 2 quarts, soft-soap 1 lb. to 18 gallons water (proportion 1 : 36).

D = petroleum 3 quarts, soft-soap 2 lb. to 18 gallons water (proportion 1 : 24).

E = petroleum 2 quarts, soft-soap 2 lb. to 9 gallons water (proportion 1 : 18).

"4th. Plants not lifted, watered, or cut. The whole of the stems and buds were painted with the following mixture:—

A = calcium sulphide 3 quarts, clay 10 lb., water 2 gallons (proportion 1 : 2·7)."

The following notes give, firstly a general sketch of the course of

treatment and experiments proposed on January 13th, to which is appended a rather fuller scheme of the experiments to be carried out so far as is possible on the bushes mentioned in the preceding list, and also on a fresh lot of bushes which have not as yet been treated:—

"Course of treatment and experiments, 1898. Discussed and proposed January 13th, 1898:—

"1st. To continue applications of the various insecticides (especially petroleum and soft-soap mixtures) throughout the season at frequent intervals; increasing the frequency of application when the buds are opening.

"2nd. To give heavy dressings of kainite, sodium nitrate, or other fertilizers.

"3rd. To cut down stems below the soil level, and cover with lime or kainite.

"4th. To raise seedlings from the least affected varieties.

"5th. To graft upon *Ribes aureum* or other species of *Ribes* which have hitherto proved free from attack.

"Experiments with *petroleum*.—Soft-soap added in the proportion of 1 lb. to each quart of petroleum. The various strengths used are as follows:—A = 1 : 10 (of water), B = 1 : 20, C = 1 : 30, D = 1 : 40, E = 1 : 80. Two sets of similar experiments to be made with Baldwin and Black Naples respectively. In each individual experiment (No. 1, 2, &c.) the bushes are dressed once a month while the buds are dormant with one of the above solutions, and after the buds start the plots are subdivided, and parts of them dressed once a month with different strengths:—

Experiments:	1	2	3	4	5	6
Before growth, dressed with	Sol. A	B	C	D	none	none
After growth, dressed with	a soln. A b ,, B c ,, C d ,, D e ,, E f ,, none	a soln. B b ,, C c ,, D d ,, E e ,, none	a soln. C b ,, D c ,, E d ,, none	a soln. D b ,, E c ,, none	a soln. E b ,, none	none

"There will be about six plants in each of the final subdivisions.

"Experiments with *calcium sulphide* solution.—Repeated on two lots of Baldwins. Similar to the petroleum experiments, except that four different strengths only are used. Strengths used:—1 : 20, 1 : 30, 1 : 50, and 1 : 100.

"Experiments with *carbolic acid* on two lots of Baldwins, similar to those with calcium sulphide. Strengths used:—1 : 30, 1 : 50, 1 : 100, and 1 : 200.

"Experiments with *antinonnin* on Black Naples; one series only,

similar to those with petroleum. Strengths used:—1 per cent., 0·5 per cent., 0·25 per cent., 0·1 per cent., and 0·05 per cent."

The above plan of treatment, it will be observed, includes,—specification of the nature of the different chemical applications with which it is purposed to experiment; the various strengths at which they are to be used; also how often they are to be used; and under what conditions of the plants. It is also purposed, by microscopic examination of contents of the galled buds which have been subjected to treatment, to ascertain precisely what the effect of the various applications has been in preventing infestation, or destruction of Acarine contents where growth has started.

From these experiments, as well as from such as turn on various methods of horticultural treatment of the bushes, it is greatly to be hoped that serviceable practical information will be gained, of which at present all Black Currant growers stand in great need.

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APPENDIX.

WEST, NEWMAN AND CO., PRINTERS, HATTON GARDEN, LONDON, E.C.